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SCIENCE AND EDUCATIONAL POLICY

THE statement of the Prime Minister that the aims of Great Britain during the present struggle must be sharply differentiated into war aims and peace aims amounted to much more than a reply to the demands for a clarification of what is to be our attitude when the War comes to an end. It is essential, however, that the wider peace aims should be constantly reiterated in order that they may remain fixed before our eyes. It would be more than regrettable if the ideals of freedom, liberty and equality that have led the Allies to take up arms were lost sight of even temporarily in our efforts to defeat the enemy. Mr. J. B. Priestley, in speaking of the drama, said recently that a momentary blurring of the objects for which we are fighting would be enough to invalidate our reasons for having gone to war.

A real and immediate problem which deserves consideration is whether a long-term national policy of scientific education ought not to be introduced into the schools of Great Britain. It is becoming more and more apparent that the provision of scientific education is far from being scientifically planned, a matter which could be adjusted by closer co-operation between scientists and educationists. Here the different forms of educational institutions would have to be considered not separately but as components of a system which aims at the development of beings whose lives are continuous processes. In this respect the insistent demand raised in the report of King George's Jubilee Trust* for continuation classes for all up to the age of eighteen should receive adequate consideration. The Industrial Revolution, the growth of the physical sciences, the mechanization of ways of living with its consequences in transport, communication and manufacture have all combined to produce an environment in which educational equipment in many cases leaves the ordinary citizen thwarted and helpless. The ideal of science is the pursuit of objective truth ; if material progress is to continue, it is essential to keep this ideal clearly in view in the prosecution of measures whereby scientific truths might be made to contribute to human welfare.

Reflection on the standard of living of masses of the population makes one painfully aware that the applications of well-established scientific truths are not being carried out in an efficient and objective fashion. There is no need to emphasize the fact that science must look for a policy which will in no respect imitate the nationalistic efforts of countries where scientific truths are distorted to conform to ideological needs. Various factors indicate that the population of Great Britain is likely to decrease during the next few years. If, as compensation, the quality of the people is to be improved, scientific workers, and especially those in the biological field, should decide the paths upon which the course of science development is to be guided.

Co-operation between scientific workers and educationists led to marked improvement in living standards of the nation while we were at peace. In these times of stress and anxiety, the value of the wider extension of scientific methods of thought and practice is apparent. The national effort will only reach its maximum when due regard is paid to the health of the nation as a whole. In this connexion, it is doubtful whether scientific workers are being allowed to play a sufficiently active part in the various schemes of food production and control. Much could be done, especially in the

* "The Needs of Youth". By A. E. Morgan. (London : Oxford University Press, 1939.)

reception areas, by the introduction of classes for teachers and youth leaders, where the specific problems bound up with evacuation could be discussed. The Workers' Educational Association, the Townswomen's Guilds and other bodies have already sponsored classes of this type. These could be usefully extended. The rural community councils and women's institutes provide means whereby scientific practice could be more quickly transferred to non-urban communities.

One aspect of this policy would be the need for greater and more effective co-operation between scientists and educationists in deciding upon the content of the general school curriculum, and in particular the science part itself. The Science Masters' Association has approached the problem in the right manner by taking steps to revise examination syllabuses in liaison with university staffs; this has resulted in the publication of reports on various subjects, including the recent one on the teaching of general science. But their scope of action is necessarily limited, and the origins of the present conflict indicate the necessity for a re-orientation of the school science content if the ideals expressed in the Spens Report are to be given effect. The Consultative Committee responsible for this report has in no wise exaggerated the case when it states that even the possibilities of science teaching have not yet been fully apprehended.

One of the more urgent problems that calls for investigation is the need for a clearer definition of the concept of social biology as an educational medium. Another avenue that could be explored with profit by scientists and educationists is the present rating of science in many school syllabuses. Apart from its use in technical and vocational training, science as an educational subject often receives poor recognition. In the Common Entrance Examination to Public Schools, for example, Latin still remains as the symbol of what is to be desired in the shape of compulsory attainment, while science is relegated to a minor, optional position. This specific instance is but a general symptom of a condition which is more widespread than is obvious on superficial examination. Such an assessment often fails to accord both science and industry their true social worth, while much useful talent is frequently diverted elsewhere. Further, in many schools science is considered to play little or no part in the process of character training; such restrictions lead to numerous psychological problems, centred upon the true worth of science, which have no real foundation. If some of these difficulties are to be adjusted, considerable effort will have to be exerted by scientific workers with an interest and enthusiasm that is based upon inflexible moral purpose and a real concern for human progress.

The difficulties encountered in the development of the Colonial Empire merit special attention. Until very recently the significance of the tropical and sub-tropical Dependencies has been viewed as through a glass, darkly. It is a tribute to our administrators that, despite this lack of interest in Great Britain, in at least some parts of the Empire it is more than probable that education is being approached in a spirit that approximates more nearly to being truly scientific than is the case nearer home. In some places excellent results are being obtained, and the part played by educationists in the establishment of stability in these rapidly evolving Colonies demands the widest recognition. The recent extension of the college for native African students at Makerere in Uganda is a new milestone in colonial development. In the Colonies, greater interest shown by scientific workers would produce even more striking results.

It has yet to be decided whether positions of importance in the Colonies should be allocated to men and women who have specialized only in one or two branches of science. Evidence comes to hand constantly to show that, whereas specialists are essential for university teaching and research posts, for general educational purposes the Colonies need people with a wider scientific training, preferably with a biological bias; it may be added that there is a body of opinion in Great Britain which maintains that this is also applicable to home conditions. For the Colonies, undoubtedly, greater attention should be paid to the recruitment of those whose task it will be both to undertake teaching duties themselves and to train and inspect native teachers in the Colonial Empire.

The planning of programmes for the present year is more than hazardous at this time, but, because of the rich opportunities which are presented, it is to be desired that responsible authorities will make at least tentative preparations for the holding of 'refresher' courses and vacation schools wherever this is possible. In general, 'refresher' courses in science have either been concerned with imparting pure academic or technical knowledge, or have served their purpose in spreading scientific knowledge and principles to

a wider audience. The latter would probably be the more fruitful course to be adopted while we are at war. Opportunities might be provided during the approaching summer for teachers, club leaders and other youth workers to be able to make refreshing contacts with members of their own professions, and to obtain valuable help and guidance from leading scientific workers and educationists. For various reasons, it seems unlikely that the Board of Education will be able to proceed with its admirable courses in science during the summer, so that the opportunities provided by other organizations would be of inestimable value.

MEMORIES OF A PALÆONTOLOGIST

Some Memories of a Palæontologist

By William Berryman Scott. Pp. vi + 336. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1939.) 17*s.* 6*d.* net.

DURING the past sixty years, American palæontologists have taken a very large share in adding to our knowledge of fossil mammals. They have not only made remarkable discoveries on their own continent, but have also worked in close association with their colleagues in other countries.

Among them during the whole of this long period, Prof. William B. Scott, of Princeton University, has been especially active, and few have ranged over a wider field. Since 1877, when he made his first collecting expedition to the West with his classmate, Henry Fairfield Osborn, until the present day, when he has joined Prof. Glen L. Jepsen in preparing a large memoir on the Oligocene mammals from South Dakota, he has travelled and engaged in research with tireless energy. His experiences therefore have been many and varied, and while occupied with his own technical problems he has seen much of the world in general. He has now recorded some of his memories in an attractive volume which will be welcomed by all who are interested in the ways of life of scientific men.

Prof. Scott, through his mother, is a great-great-great-grandson of Benjamin Franklin, and he began life at Princeton in unusually intellectual surroundings. From the beginning his inclinations were towards natural science, and when he was a schoolboy his interest in geology was first roused by his grandfather who made some casual remarks to him about the nature of coal. At Princeton he studied under Prof. Arnold Guyot, whom he eventually succeeded in the professorship of geology. In London he attended Prof. Huxley's course in comparative anatomy; at Cambridge he studied embryology with Francis M. Balfour; and at Heidelberg he spent much time in research under the direction of Carl Gegenbaur. He was thus well equipped for both geological and biological work, and he gives many interesting reminiscences of his teachers and distinguished fellow students. His visits to Europe also brought him into contact with other leaders in geological and biological science of whom he records impressions. His experiences of England and Germany seem to have been particularly happy.

Prof. Scott has much to say of life in Princeton, where he witnessed the growth of the old College into the University. He describes his expeditions to the West to collect fossils, beginning in the days when the Indians were still troublesome; and he makes many references to the rivalry of Cope and Marsh, who were his predecessors in the field. There are also observations on South Africa, which he visited with the British Association in 1905; on Panama, which he visited in 1911; and on Spain, where he attended the International Geological Congress in 1926.

Prof. Scott's most important work outside North America was his organization of the Princeton University Expedition to Patagonia under Hatcher and Peterson during 1896–99. Between 1901 and 1931 he edited the series of handsome volumes which record the results, and he himself contributed most of the descriptions of the fossil mammals. In 1901 he visited the Argentine so that he might study and photograph the fragments of similar fossil mammals in La Plata which had already been described by Ameghino and others. Reminiscences of this journey occupy an interesting chapter.

During the past few years Prof. Scott has not only continued the researches on Oligocene mammals already mentioned, but has also published new editions of his well-known "Introduction to Geology" and "History of Land Mammals in the Western Hemisphere". He has rewritten the greater part of the latter book and made it an indispensable up-to-date work of reference. Now that he is an octogenarian, he adds to our indebtedness by giving us a stimulating collection of memories, which show how wide may be the outside interests of one who devotes himself to palæontology. ARTHUR SMITH WOODWARD.

PLANT VIRUS DISEASES

Plant Viruses and Virus Diseases

By F. C. Bawden. (A New Series of Plant Science Books, Vol. 5.) Pp. xii+272. (Leiden: Chronica Botanica Co.; London: Wm. Dawson and Sons, Ltd., 1939.) 7 guilders.

THE earlier investigations of virus diseases of plants were attempted by the standard methods of the plant pathologists, and failed to reveal the cause of the disease, or to elucidate the nature of the infective agents. These methods have been supplemented by a technique of the widest biological basis, including that used by biochemists and physicists to investigate proteins and other compounds of high molecular weight. The author, with his colleagues, has played a prominent part in the isolation, purification and chemical recognition of nucleoproteins obtained only from infected plants. His hypothesis, freely accepted to-day, considers the nucleoproteins to be the viruses; this forms the theme of his book, which might with advantage have been entitled "Recent Research on the Nature of Plant Viruses". Thus it differs, particularly in outlook but also in treatment, from other recent text-books of virus diseases which are primarily concerned with the economic host plants; this one especially considers the infective agents.

In the introductory pages the author criticizes with acumen suggested schemes of classification or nomenclature based largely on records of host plants infected; in later chapters a classification based on the actions and properties of the viruses is put forward. Such a desirable change can only take place when sufficient knowledge of the viruses is gained; whereas little benefit and considerable confusion may arise from reshuffling an artificial system of nomenclature, the earlier classifications were based on the limited available facts chiefly concerned with the host plants.

Botanical readers, some perhaps less familiar with serological technique, will find these methods described as they are now utilized in virus research. Evidence shows that the viruses are themselves the antigens; for the purer the virus preparation the more active it has proved, and further, a common antigen may be obtained, for example, from plants of tobacco and phlox, infected with the virus causing tobacco mosaic. Crystalline nucleoproteins have given results of the same order, and are now regarded as the antigens specific to virus-infected plants. This is part of the experimental foundation of the author's hypothesis. Serological technique has also proved of value in identification of the viruses and can be used to distinguish strains of the same virus.

Since Stanley (1935) claimed to have isolated the tobacco mosaic virus, much progress has been made in the methods of purification, and the text shows those employed to obtain samples of tobacco mosaic, potato 'X', tomato bushy stunt, and tobacco necrosis viruses. One yield of 80 per cent of the total protein content of the sap expressed from frozen leaves has been claimed to be virus; but in other cases cited, 2 gm. per litre of cell sap are considered to be virus. From healthy plants no such compounds are obtained by similar procedure.

Later chapters deal with the composition of viruses as revealed by chemical analysis—where the phosphorus and carbohydrate derived from the nucleic acid are of vital importance as without such fractions activity is greatly reduced—and with their optical and other physical properties, including crystalline structure studied by X-rays. Estimates of the size of the particles and their molecular weight are included. A brief account is given of the limited work that has been carried out on the physiology of virus-infected plants. The author reviews possible control measures and considers the breeding of resistant varieties to be a slow but promising line of work. Protection afforded by chance or deliberate infection with mild strains, valuable as it is with certain crops, is not considered likely to be of general use; it appears impracticable to 'vaccinate' plants against more than one virus because of the interactions and complications that may ensue.

In the concluding pages attention is focused upon the question so frequently asked by the earlier investigators: Are viruses living organisms? A straightforward definite answer cannot be given. Further knowledge regarding the activities of viruses in living tissues is needed. In the meantime it is necessary to re-examine carefully the criteria applicable to this judgment in the light of the information already known about viruses.

The book forms a readable account of recent brilliant research, the facts are authentically presented, and the literature adequately surveyed. Here and there a few trivial errors in the type have escaped the proof reader's attention; there are several short reiterations in the introductory paragraphs to the chapters. Biologists are deeply indebted to Mr. Bawden for his critical survey of the progress so recently made in this field of research.

YOUTH ON THE PROW IN CHEMISTRY

Young Chemists and Great Discoveries
By Prof. James Kendall. Pp. xvi + 272 + 23 plates. (London: G. Bell and Sons, Ltd., 1939.) 7*s.* 6*d.* net.

IN this book of the Royal Institution Christmas Lectures of 1938–39, Prof. Kendall records how "the youthful breast, inspir'd by truth's bright ray", arrived at some of the most spectacular discoveries in the history of chemistry. Following Ostwald, he divides his youthful paladins into two classes: the romantic and the classical, exemplified by Davy and Faraday. As one would have anticipated, his first lecture was devoted to the romantic Humphry Davy, an ideal subject for such a theme, such an audience, and such a place. Then followed naturally that wonderful example of the age-old story of the master and the apprentice provided by the interwoven careers and contrasting personalities of Davy and Faraday.

Davy carried out his dramatic experiments on the inhalation of nitrous oxide at the age of twenty; at twenty-two he took London by storm through his brilliant lectures at the Royal Institution; at twenty-four he was elected to the Royal Society; at twenty-eight he discovered potassium. Here, then, is a perfect example of the youthful genius in chemistry.

However, like van 't Hoff, who also leaped to fame at the age of twenty-two, Davy had burnt himself out at fifty. Indeed, from Prof. Kendall's examples it seems that if the romantic type be symbolized by Davy's flaming globule of potassium, the classical type may be likened to the candle, about which Faraday lectured so aptly and charmingly to his juvenile auditory at the Royal Institution. Faraday's first important discovery was made when he was about thirty, and the flame of his genius shone clear and steady until he entered into the twilight of a long and fruitful life.

Prof. Kendall's story, always interesting and animated, ranges from Davy and Faraday through Perkin, Couper and Kekulé, Pasteur and van 't Hoff, Arrhenius and the Braggs, Newlands and Mendeléeff, Bohr and Moseley, to the "first young heroine", Madame Curie, and ends across the Atlantic with Robert Hare, Charles Martin Hall and Irving Langmuir (who characteristically took his seat in a row labelled 'Juveniles Only' at Prof. Kendall's first lecture). The narrative thus traverses an extensive field, and Prof. Kendall's clear and easy style enables him to introduce his readers, as he introduced his juvenile auditory, to such complexities as structural formulæ, polarized light, asymmetric molecules, ionization, the classification of the elements, isotopes and radioactivity.

It is difficult to discover flaws in this entertaining story, although on one or two occasions it may be felt that Prof. Kendall shows a little indulgence to his young heroes. Thus, in defending Davy against those who have accused him of vanity and snobbery, Prof. Kendall quotes Dalton's statement: "The principal failing in his character is that he does not smoke." This testimonial to Davy's character becomes less impressive, however, when one refers to Dalton's original letter, which reads: "The principal failing in his character as a philosopher is that he does not smoke." Moreover, it is scarcely fair to one who has been called "the Scotch Faraday" to say that "only the mighty Faraday roused Liebig's admiration" among the chemists he met in England in 1837; for at that time, as Tilden has remarked, "Faraday having long abandoned the pursuit of pure chemistry, the most famous by far among English [that is, British] chemists was Thomas Graham", who certainly won Liebig's high approbation. "I had a very long and agreeable letter from Liebig a few days ago," wrote Graham to his sister Margaret on November 24, 1837, "conveying the information that his University have made me a Dr. of Philosophy *causâ honoris*. . . . He has a grand project of publishing a chemical journal in three languages, to be edited by Liebig, Dumas, and myself."

As Prof. Kendall points out, several famous chemists have been poets, and the youthful Davy was also the subject of anonymous sonnets from fair admirers. We suspect that if Prof. Kendall had not been an eminent chemist he would have achieved fame as a dramatist, if not indeed as an interpreter of the drama. His lectures were rich in dramatic moments and quick changes. His book, too, ends on a dramatic note. As we are about to lay it down we discover that the "young chemist" whose classical features adorn the dust jacket is not Davy as we have hitherto supposed. To our surprise this charming illustration proves to be an early portrait of Albert Edward, Prince of Wales, afterwards King Edward VII, who in his youth received instruction in chemistry from Lyon Playfair at Edinburgh and took part there in the dramatic experiment with boiling lead which is described at the close of Prof. Kendall's

book : "the lecturer and his two gallant volunteers in turn passed their hands to and fro through the stream [of white-hot lead], and the final experiment of the 113th course of Christmas Lectures adapted to a juvenile auditory to be given at the Royal Institution was carried to a successful conclusion".

This absorbing account of youthful achievement in the realm of chemistry cannot fail to arouse and hold the interest of readers of all ages. The volume is attractively produced and copiously illustrated with plates and figures. It contains references to many of the experiments and exhibits of the original lectures, and each chapter is provided with a useful bibliography. The book gives rise to sundry interesting reflections. What was the spark causing the tinder of each youthful genius to burst into flame ? Is there still scope in science for the youthful pioneer, in these days of intense specialization and team work ? Would Faraday, with his meagre formal education and elementary knowledge of arithmetic, have been able in this exacting age to break his birth's invidious bar ? These are some of the intriguing questions to which the intelligent reader must supply his own answers. JOHN READ.

GENETICS OF COTTON

The Genetics of Cotton

By Dr. Sydney Cross Harland. Pp. 193. (London : Jonathan Cape, Ltd., 1939.) 10*s.* 6*d.* net.

THE great economic importance of the world's cotton crop has led to marked advances in the genetics of cotton since 1924, when the most valuable New World species of cultivated cotton were found to be tetraploid. The researches of Dr. Harland have occupied a leading place in this development, and the present book is a fitting summary of knowledge regarding the genetics and cytology of the genus Gossypium.

The first chapter, which is devoted to the taxonomy of the group, recognizes eighteen species, while ten others recognized by some authors are reduced to variety rank and two are assigned to other genera. In addition, *Gossypium Robinsonii*, of Western Australia, is insufficiently known and recent efforts to find it in the wild condition have been unsuccessful. Numerous specific names of cottons in the West Indies and South America are regarded as local races of *barbadense* or *purpurascens*.

The fact that four American and three Polynesian species are tetraploids with 52 chromosomes is of fundamental importance for the genetics of the cultivated cottons. The existence of five wild American diploid species, as well as other diploid species in Africa, Asia, and Australia, shows not only the great age of the genus (regarded as Cretaceous in origin) but also serves as the basis for various views regarding the origin and history of the valuable American tetraploids (Sea Island, Upland, etc.). It is evident that these form a younger section of the genus, having been derived, probably as allotetraploids, from diploid ancestors.

The cytological chapter presents the available evidence from chromosome morphology as well as number, and particularly from chromosome pairing in F_1 interspecific hybrids. Supposed constant differences in chromosome size between the Old and New World species have led to the view that the American tetraploids have resulted from chromosome doubling in sterile hybrids between species from these respective original sources. The chromosome sizes in these presumed amphidiploids do not apparently support this view, and Upcott's reinvestigation of the case of *Æsculus carnea* does not show (as is stated on p. 44) that this amphidiploid has 40 large chromosomes derived from one parent and 40 small ones from the other. Nevertheless, although the evidence of chromosome size gives little support to the view that the American tetraploid species came from crosses between Asiatic and American diploids, yet the pairing in F_1 hybrids does support such a conclusion, for certain crosses between Asiatic species and New World tetraploids give thirteen pairs and thirteen single chromosomes. The evidence is not final, but the existence of tetraploids in Polynesia suggests that this condition goes back a long way in the history of the cottons.

The bulk of Dr. Harland's book is naturally devoted to the numerous results of breeding experiments. Several series of multiple allelomorphs are known, some members of which belong to different species, as in red pigmentation, leaf shape and seed fuzz. Several cases of linkage groups have been found, but with the large number of chromosomes it will be a long time before adequate chromosome maps can be constructed.

This book will be indispensable to all those concerned in cotton breeding, and to geneticists, especially for the work on interspecific modifying genes in a group of species the age of which can only be measured in geological time.

R. RUGGLES GATES.

SOME BIOLOGICAL APPLICATIONS OF NEUTRONS AND ARTIFICIAL RADIOACTIVITY*

By Dr. John H. Lawrence,

Radiation Laboratory, University of California, Berkeley

THE biological and medical sciences are being stimulated and benefited by the recent discoveries of the nuclear physicist in a manner similar to that following the discovery of the naturally occurring radioactive elements and the production of X-rays. The nuclear physicist can now induce radioactivity in practically all of the elements, and he can harness a beam of neutrons of intense biological activity. This new wonderland for the biologist has been brought about by such events as the first successful experiments of Joliot and Curie in artificial radioactivity, the discovery of the neutron by Chadwick, the discovery of heavy hydrogen by Urey, and the development of the cyclotron by E. O. Lawrence and his associates.

During the past four years, workers at the University of California have been intensely interested in the biological applications of these products of the physicist, and recently a new medical-biological laboratory dedicated to this study and housing the new 220-ton cyclotron—the William H. Crocker Radiation Laboratory—has been completed in Berkeley. Because of its ability to produce large quantities of the various radio-elements and neutron rays, the cyclotron is the nucleus of this unit. The Laboratory is, however, staffed not only by physicists, but also by chemists, biologists, cytologists, bacteriologists, physicians and radiologists—all of whom are interested in both the fundamental and practical problems concerned with the interaction of radiation and matter. My purpose here is to discuss briefly some of the investigations carried on in this laboratory or in conjunction with it. Unfortunately, there is not sufficient space to discuss the extensive and important work being done in this field in other laboratories.

When Hevesy first used radium D, an isotope of lead, as a 'tracer' of lead movement in plants, the potential value of similar isotopes of elements which are important in physiological processes, such as phosphorus, sodium, iron and iodine, became apparent. These and other radioactive isotopes are now available; and, since they are chemically like their inactive relatives, their radiations simply label or tag them and enable the investigator (with the aid of a Geiger counter) to study their average exchange and distribution in biological and chemical processes, in health and disease. The effect of irradiation on the reaction is avoided by the use of sufficiently small 'tracer' amounts. On the other hand, many of these isotopes may be used as potent sources of radiation if the metabolism of the element in question is not being studied. In Table 1 are listed some of the isotopes that are used in this University. A brief discussion of studies in which these isotopes are employed follows.

Table 1.

Atomic number	Radio-element	Radiation	Half-life
1	Hydrogen (3)	Beta	150–170 days
6	Carbon (11)	Positron and gamma	20·5 minutes
11	Sodium (24)	Beta and gamma	14·8 hours
15	Phosphorus(32)	Beta	14·3 days
16	Sulphur (35)	Beta	88 days
17	Chlorine (34)	Positron and gamma	33 minutes
19	Potassium (42)	Beta and gamma	12·4 hours
20	Calcium (45)	Beta and gamma	180 days
26	Iron (59)	Beta and gamma	47 days
35	Bromine (82)	Beta and gamma	34 hours
53	Iodine (126)	Beta and gamma	13 days

Radioactive hydrogen is written ${}_1H^3$, in contrast to ordinary hydrogen (${}_1H^1$) and heavy hydrogen (${}_1H^2$), and has only recently been discovered by Alvarez and Cornog of this Laboratory. This newly labelled form is used in biological work and promises to become a valuable adjunct to heavy hydrogen, which has been so extensively used in 'tracer' studies. Although radio-carbon has a very short half-life (20·5 minutes), Ruben, Hassid and Kamen are successfully using it in the study of photosynthesis. Leaves of barley plants grown in an atmosphere of C^*O_2 form radioactive carbohydrates†, even when the plants are kept in darkness prior to exposure to C^*O_2. The bulk of the radioactive material found in the plant is water-soluble and does not contain carbohydrate, carbonate, keto acids or pigments. Jenny and Overstreet of the College of Agriculture grew barley in the presence of K^* and showed that the intake of ions is not a uni-directional process, but that

*Based in part on a paper given before Section A (Mathematical and Physical Sciences) of the British Association, given on August 31 and September 1, 1939, at Dundee.

†The radioactive form of an element is denoted by an asterisk.

ions of the same species may move into the root and out of the root at the same time. Stout and Hoagland of the same department, using the radioactive isotopes of potassium, sodium, phosphorus, and bromine, studied their upward movement after absorption by the roots in actively growing willow and geranium plants. They found that when salts are absorbed by roots, some portion enters the xylem within very short periods of time, and is carried rapidly towards the leaves under the influence of transpiration. That the content of radioactivity in the bark as compared with the root is slight indicates that movement of salts in the former is very slow.

Mullins, of the Department of Zoology, has investigated the effect of increasing activities of radio-sodium on the penetration of Na^+ into the single-celled alga Nitella. His results show that, below certain activity concentrations, there is no 'radiation' effect, and point out the importance of using low activities in 'tracer' work. Hamilton is making an extensive study of the physiology of the isotopes of sodium, potassium, iodine and other elements, in health and disease. Their rapid absorption and distribution is evidenced by their appearance in the hand a few minutes after oral administration of small amounts. The isotope of iodine is proving to be valuable in the study of thyroid physiology. Hamilton has demonstrated the marked concentration of ingested iodine in the thyroid gland and has been able to photograph the distribution of iodine by placing the excised gland on a photographic film. Anderson and her associates of the Institute of Experimental Biology have found that in adrenalectomized rats a single dose of 'tagged' sodium is rapidly lost, while potassium tends to be retained.

Radio-phosphorus (P^{32}) has been the most extensively used radioactive isotope. The ease of manufacture in the cyclotron and its relatively

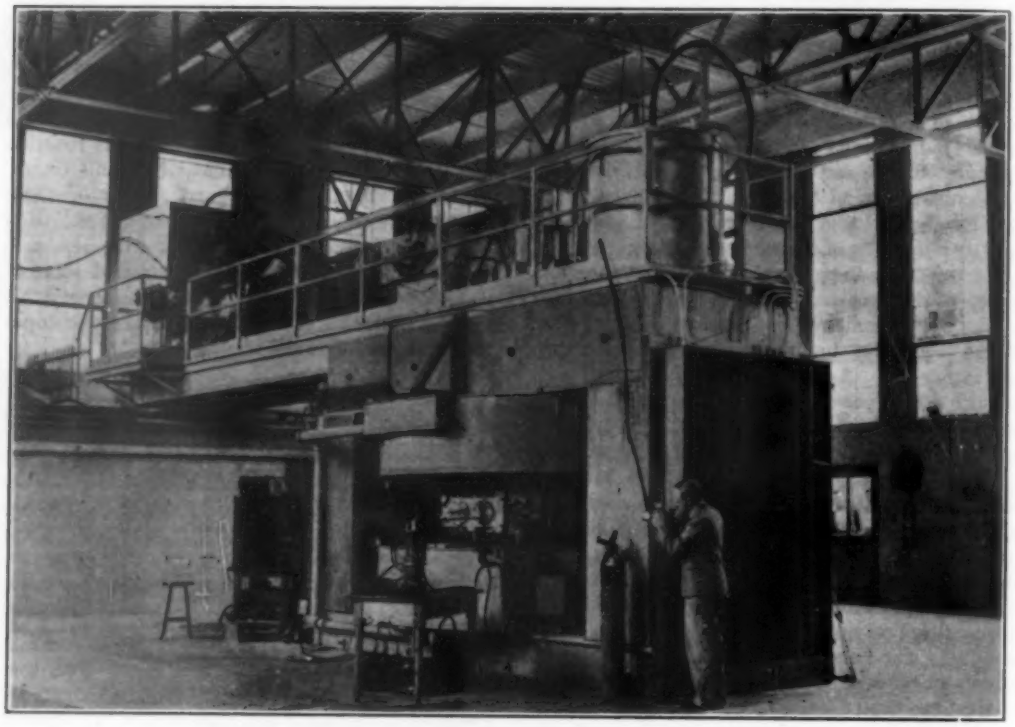

Fig. 1.

THE 200-TON 60-INCH CYCLOTRON IN THE CROCKER RADIATION LABORATORY ON THE BERKELEY CAMPUS OF THE UNIVERSITY OF CALIFORNIA.

Standing by the corner of the magnet and adjusting the helium flow to the target chamber is the late Dr. Harold Walke, of the University of Liverpool. On the table in the foreground is an experimental deuterium generator. The target chamber is behind, marked by the two port holes. Above and to the rear is seen the aluminium oscillator house or radio-frequency power supply. Photograph taken by Dr. Donald Cooksey, assistant director of the Radiation Laboratory.

long half-life (14·3 days) make it ideal for biological studies. Chaikoff and his associates in their studies of phospholipid metabolism have shown that various kinds of neoplasms in animals have individual rates of phospholipid turnover, and that cell type does not seem to be the determining factor. In association with Scott and Tuttle, the metabolism of labelled phosphorus in leukæmia in both animals and man is being investigated. The finding that in leukæmic mice the phosphorus turnover is apparently proportional to the degree of leukæmic infiltration suggested the use of radiophosphorus as a source of radiation in the treatment of leukæmia in humans. The concentration of the radio-phosphorus in the areas infiltrated with leukæmic cells tends to localize the therapeutic irradiation (beta-rays). Given by mouth in the form of sodium phosphate, phosphorus is well absorbed (75 per cent) and slowly excreted (2 per cent per day). The turnover of phosphorus in red cells is rapid, whereas the white cells retain it for longer periods of time. Numerous patients suffering from chronic leukæmia are being treated with this material, and in many instances remissions in the disease are obtained.

Tarver and Schmidt, of the Department of Biochemistry, have synthesized methionine from radio-sulphur and, after feeding it to rats, have shown that the radio-sulphur may later appear as cystine extracted from the tissues. Finally, Whipple and his associates at the University of Rochester, in their studies on normal and anæmic dogs, report the following: radio-iron is poorly absorbed by normal animals; anæmic animals absorb iron in proportion to their need for it; plasma is the medium for the transport of iron; the rapid appearance of iron in the red blood cells is spectacular.

The intense beam of neutrons produced by the cyclotron has made it possible to investigate their biological effects on various objects such as bacteria, plants, Drosophila eggs, animal tumours and normal mammals. This new penetrating form of radiation has intense biological effects, even greater than X-rays or gamma rays, on normal and tumour tissue, but when compared with X-rays, selectively affects some tissues more than others. Experiments on animals indicating that neutrons are more destructive to neoplastic tissue than to normal tissue suggested their trial in cancer therapy. In association with R. S. Stone, of the Department of Roentgenology, patients suffering from cancer are now regularly being treated with neutrons from the new 60-inch medical cyclotron. The recent experiments of Kruger in this Laboratory have opened up another possible application of neutrons to cancer therapy. He has demonstrated that cancers from mice placed in non-toxic concentrations of boric acid and irradiated with slow neutrons can be killed with doses of irradiation harmless to tissues not in contact with boron. The slow neutron is captured by the boron nucleus. The combination emits two heavy ionizing particles in opposite directions—an alpha particle and a lithium nucleus—which traverse a distance of about 7 μ in tissue and thus approximate an explosion within the cell.

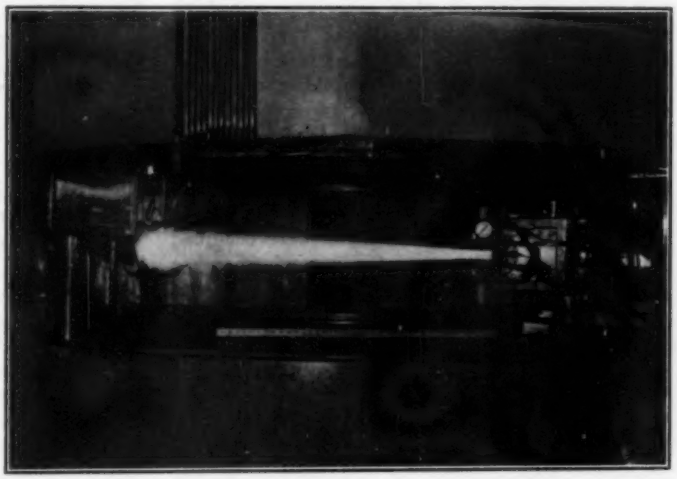

Fig. 2.

THE PATH OF A 16-MILLION ELECTRON VOLT DEUTERON BEAM TRAVERSING THE AIR FOR A DISTANCE OF NEARLY FIVE FEET.

These particles emerge from the vacuum of the target chamber with a velocity of approximately 18,000 miles per second. In slowing down over the course of their path, they give up their energy to the air molecules, causing them to glow with a violet light. However, in practice, a target to be made radioactive is placed at the emergent point of the beam and thus bombarded. Where neutrons are desired the target used is beryllium. Photograph taken by Dr. Donald Cooksey, assistant director of the Radiation Laboratory.

Although the great contribution of the new nuclear physics to the problems of biology and medicine is certainly the 'labelled' or 'tagged' isotope, nevertheless it seems important to pursue the possibilities of artificial radioactivity and neutron rays in cancer therapy until a more satisfactory answer to this problem has been reached.

MOUND EXPLORATION IN THE TENNESSEE VALLEY, U.S.A.

THE operations of the Tennessee Valley Authority in the United States of America, by the erection of dams to collect and control the waters of the Tennessee River and its affluents, will inundate to a considerable depth a vast tract of land, which to the archæologist and the student of the pre- and proto-history of the indigenous peoples of America is one of the most interesting regions of the continent north of the tropics. Unfortunately, in a cultural sense it is still incompletely understood. Though a great part of it, and curiously enough that especially suited to aboriginal pursuits and modes of life, was still unoccupied by surrounding tribes, possibly owing to mutual rivalries, when first visited by the white man in the sixteenth century, nevertheless the whole country abounds in evidence of prehistoric occupation in the form of mounds, shell heaps, stone implements, pottery, old fields, burial caves, and ancient cemeteries. From about 1660 onwards, these vacant lands were occupied successively by Shawnee, Chickasaw, Cherokee and Creeks, with a number of lesser tribes of uncertain affinities.

So early in the history of the Tennessee Valley Authority project as 1933, it was pointed out that the building of the dams and consequent flooding of large areas of the valley would destroy these records of prehistory for all time, unless some plan of conservation could be undertaken. Already the construction of the Wilson Dam, near Florence in Alabama, by the United States Government during the War of 1914–18, had created a lake 23 square miles in area; and to this inundation a further 100 square miles was now to be added. Accordingly, towards the close of 1933, a conference was held at Knoxville which was attended by representatives of the Authority and the Universities of Tennessee and Alabama, with Mr. Niel M. Judd of the Smithsonian Institution as consultant. As a result, archæological surveys of the areas affected were instituted and a number of excavations have been carried out with moneys provided out of Federal funds for the relief of unemployment, with the assistance of grants from universities and other learned bodies. Reports on the results of the survey work and excavation will, for the most part, be published when ready by the Smithsonian Institution of Washington.

Although the existence of a large number of mounds and other prehistoric remains in the great river-valley system, Ohio–Tennessee–Mississippi, of the United States has long been known and their character frequently described and discussed, it is only of recent years, thanks mainly to the work of Mr. Warren K. Moorhead and a small band of enthusiastic investigators, that anything approaching real understanding of the mound-culture has begun to emerge. At the moment, the focus of the problem is the distribution affinities and development of the 'Hopewell' culture, of which outstanding characters appear in what follows.

A more general characterization of the culture of these mounds, however, is given by T. M. N. Lewis, of the University of Tennessee, in a preliminary report to the American Philosophical Society on archæological investigations in the Tennessee Valley during the past five years, to the cost of which the Society had made grants from the Penrose Fund in aid of research[1].

A large quantity of documented archæological material and skeletal remains was obtained, from which the most interesting result to emerge, pending further and more detailed analysis, was the apparent linkage of the aboriginal peoples of Tennessee with those of Middle America. The large earthworks having the form of truncated pyramids, which have now been meticulously excavated, follow in cruder fashion the methods of construction of the temple pyramids of Central American lands, in which the ruins of temple buildings are found to surmount superimposed substructures. Here in Tennessee, however, the substructures are not stone-plated, as they are in the south, but are constructed of clay, whereas the superstructures, in which the religious ceremonies and business of government were carried on, were of poles, bark, cane and clay instead of stone. Elevated square or circular fireplaces constructed from puddled clay are always present in the centre of the floors. Occasionally elevated rectangular platforms and seats of hard-burned clay have been found. Changes in architectural details of the superimposed structures suggest changes in cultural occupations, which, as will be seen, are supported by analyses of the evidence. Stairways or ramps lead to the summits of the structures.

In some instances, although these structures were intended to be the town's chief ceremonial house, interments of important individuals in pits beneath the floor-levels were made. Nearly always these are lavishly accompanied by mortuary

offerings of pearl and shell beads, copper ornaments, engraved shell gorgets, and other implements and utensils of bone, stone, shell and pottery.

The villages were small, and only in rare instances could the number of inhabitants have exceeded 1,500 or 2,000 individuals. The huts were small and rude, and in close proximity one to another; the dead were buried either at haphazard throughout the village, as in the Chickamauga Dam Basin, near Chatanooga, or in cemeteries, as in central and western Tennessee.

A detailed report on key positions in the Wheeler Basin of northern Alabama which had been excavated under his direction has been made by William S. Webb, with supplements on the geology and topographic features of the region and their effect on aboriginal occupation, by Walter B. Jones, State geologist of Alabama, a study of the physical anthropology and pathology of the skeletal material by Prof. W. D. Funkhouser of the University of Kentucky, and an analysis of the ceramic material by Dr. James B. Griffin, of the University of Michigan[3].

On the general character of the relation of aboriginal occupation and geological and topographical conditions, it may be said that as a rule the principal villages or settlements with or without mounds were on level ground adjacent to rivers or lakes. Often there is an amazing amount of kitchen midden material in one or more portions of each settlement. In Tick Island, for example, refuse reaches a depth of 8 ft. for an area of nearly two acres. Other examples are the shell mounds, composed of shells, animal bones, stones, pebbles, flint chips, fashioned and broken objects, potsherds, fish remains, charcoal and occasional human burials. Mounds of this type are often so much as 200 ft. wide, 600 ft. long and 15–20 ft. high, with 60,000–100,000 cubic yards content, all left over from primitive kitchens. An archæological map prepared on the basis of material collected in a preliminary archæological survey in 1932 shows 237 sites distributed over six counties. The key sites selected for investigation numbered nineteen.

In general terms, the culture or cultures of these sites, of which the excavation is described *seriatim* in detail, may be characterized on stratigraphic evidence as a sequence. The earliest form is a pre-pottery culture, in which the bow had not come into use. Its place was filled by the *atlatl* or throwing-stick. Spear points appear in great number, associated with a broad-bladed flint knife. Apparently bodies were buried without the flesh, though the occurrence of numerous burnt bones need not necessarily denote cannibalism. Above this from a level of 6–7 ft. below the surface was evidence of a culture in which all burials were in the flesh, and with them were associated marine shells, pottery vessels, and copper. In certain instances burials were in a shell midden containing much flint and many potsherds. Frequently the head was detached and alone buried. It is by no means certain that all the burials in the mounds are of the culture with which they are found.

A burial mound in Tick Island was quite in contrast with other sites in the vicinity, having a number of distinctive cultural traits, which cannot be connected with any other sites or known racial stock. Nothing but pottery, surprisingly, was used, and in quantity, for burial offerings. Some burials were flexed, some extended, but the most common practice was the burial of the detached head. All mortuary vessels were shell-tempered, while detached sherds were all gravel- or sand-tempered. The significance of this will appear later. A very unusual open bowl with much elevated strap handles and rows of protuberances has also been recorded on a number of sites along the Tennessee in north Alabama.

The association of outstanding stone artefacts with copper artefacts, particularly copper reel-shaped objects, leads to discussion of the distribution of these last. The practice of depositing these copper reel-shaped objects in burial mounds is found to centre in a comparatively small area, embracing the counties of northern Alabama. A comparison of the sites produces a very constant complex of thirty-six cultural traits, to which on account of the consistent association of copper, especially the reel-shaped objects, and galena with burials, the name of the 'copper-galena' complex has been given. The people of this culture obtained and worked native copper, buried galena with their dead, possessed many ocean shells, practised ceremonial destruction of artefacts and produced woven fabrics. They were either well on the way towards developing a specialized sedentary culture, or else they represent the degenerate form of a higher cultural complex.

In either event, although neither history nor tradition presents any suggestions for their connexion with tribes who later inhabited this territory, it is noted that they occupied the territory where de Soto (1540) reported the Yuchi to be living; while an examination of the traits here considered to be fundamental in the copper-galena complex leads to the conclusion that it may be regarded tentatively as a manifestation of the Hopewellian phase—a phase centring in the Hopewell culture of Ohio, which was the result of the high development of an able people, who over a long period of time "drew to themselves the best cultural and material wealth from a large

area, and like many a metropolis of modern times, radiated a powerful influence on customs and techniques to all less-favoured areas".

The reference to the temper of the pottery of Tick Island calls for further elucidation. In the report on pottery by Dr. Griffin, it is pointed out that the distinguishing characteristic most easily definable in the analysis of the sherds from six sites submitted to him was the type of temper; it was of primary importance in recognizing and distinguishing the culturally complete ceramic types. As a rule, Dr. Griffin points out, temper is not a reliable diagnostic trait. Yet there is, for example, no evidence that the makers of the shell-tempered pottery had any cultural contact with the users of sand or fibre for tempering. Although pottery containing limestone has contacts with that containing clay or grit, such evidence is lacking for sand and fibre, although both types of pottery occur on the same site.

[1] "The American Philosophical Society: Year Book, 1938" (Philadelphia, 1939).

[2] "An Archæological Survey of Wheeler Basin on the Tennessee River in Northern Alabama". By William S. Webb. Smithsonian Institution, Washington, D.C., Bureau of American Ethnology, Bull. 122; 1939.

INTERGRADING AMONG PLANTS IN RELATION TO THE PROVENANCE OF FOREST TREES

By DR. R. MELVILLE,
ROYAL BOTANIC GARDENS, KEW

IT has long been known that the geographical source of the seed of forest trees is important if a well-grown and healthy plantation is to be achieved and yield a profitable return. For some years experimental plantations of European Larch have been grown by the Forestry Commission from seed of several Scottish and Continental sources. Attention has been focused to an increasing degree on the question of seed provenance in an effort to obtain varieties capable of giving high yields under a variety of soil conditions in different parts of the country and able to withstand frosts and fungal diseases. With the object of stimulating interest in the question, a discussion on seed provenance and local races of forest trees had been arranged between Sections K (Botany) and K* (Forestry) of the British Association at Dundee, but did not take place before the cancellation of the meeting.

A considerable volume of research on seed provenance in forest trees has been carried out on the Continent, by far the greater part of which has been concerned with conifers, especially Scots Pine, European Larch and Norway Spruce. Much of the work has had a physiological bias. The relationship of seed source to the complex of characters resulting in frost hardiness and the ripening of the shoots has been studied. Rate of growth and growth periodicity are important also and interact on the quality of the resulting timber. Among the morphological characters compared in strains of different origin are the growth habit and the form of the root system, both of which may have a profound influence on the yield under particular conditions, as well as on the form of leaves, buds and cones. It is not possible here to do more than indicate the extent of the wide field already covered by numerous experimenters, but able summaries are given by Langlet[1] and Kalela[2]. The purpose of this article is to point out the relationship between some recent developments in experimental taxonomy and the question of provenance.

The correlations between morphological characteristics of adult trees of different strains and their sylvicultural value so far attempted have been based in the main on the conception of species and varieties as discrete entities, varying but little and more or less easy of recognition. This is a conception related to the classical taxonomy, in which plant forms are often described from one or a few similar individuals. Frequently this is unavoidable, as when the only specimens available have come from a single collecting expedition in isolated or difficult territory. Nevertheless a somewhat static view of the species as an individual results. In settled countries where extensive investigations of the flora have been made, material is available or can easily be obtained for intensive and critical studies of particular species or species groups. Such studies lead to a more dynamic view of a species as a constantly varying population in which the characters of the component individuals intergrade. To enable the foresters to make the most intelligent use of this intergrading, the taxonomist must first produce a classification in which it is embodied. The recent treatment of intergrading is a step in this direction.

Intergrading may occur within a species or between related species capable of interbreeding.

In the case of intra-specific variation, the individuals composing the species can be arranged in an orderly sequence dependent on the gradation of a particular character or group of associated characters. Huxley[3] has proposed the term *cline* for such graded series, with suitable prefixes to denote different types of cline. In connexion with the provenance of forest trees, the kind of cline likely to become of most general interest is that in which the character gradient is related to geographical distribution. For this Huxley proposed the term *geocline*, though *topocline*, as later suggested by Gregor[4], is preferable since 'geocline' suggests a cline dependent on differences of soil. Also, in the future, it may be necessary to use 'geocline' in the latter sense. Huxley quoted as examples of topoclines the intergrading between the wrens of the Shetlands, Fair Isle, the Orkneys and mainland of Britain, with several more among animals, but none in plants. The occurrence of geographical character gradients, however, is probably as common among plants as animals, and little research is necessary to bring them to light. The cedars, for example, form a graded series from west to east beginning with the Atlas Cedar, *Cedrus atlantica*, of the Atlas Mountains, followed by the Cedar of Lebanon, *C. Libani* of the Lebanon Mountains and Cilician Taurus, and ending with the Deodar, *C. Deodara*, of the Western Himalaya. In geographical order the leaves increase in length from west to east, while the number of leaves in each yearly fascicle on the short shoots decreases in the same order (Fig. 1). Hooker, Henry, Dallimore and others considered these forms as varieties of one species, and at the same time retained separate specific names mainly on account of the discontinuous distribution. Continuous variation with geographical gradients probably exists in the European Black Pines, *Pinus nigra* Arnold; the variety in the Pyrenees and Cevennes, var. *cebennensis*, has the longest and most slender needles, the Corsican Pine, var. *calabrica*, has needles of intermediate length and thickness, while the Austrian Pine, var. *austriaca*, has the shortest and stoutest needles of the western European forms. In North America the southern forms of the Shagbark Hickory, *Carya ovata*, have pubescent leaves and branchlets, while forms in the northern United States and Canada are glabrous or nearly so. An examination of the available herbarium material revealed some intermediate forms from the intervening States, and it seems probable that a north to south gradient exists in degree of pubescence in this hickory.

Lindquist[5] mentions a north to south gradient in the leaf shape of the common Wych Elm, *Ulmus glabra* Huds., which in the northern parts of its range in Europe has narrow leaves and in southern parts broad leaves. Field work in Great Britain has confirmed the existence of a north to south topocline in leaf and stem characters in this elm. From Durham northwards spontaneous or subspontaneous individuals bear relatively narrow leaves (ratio of length to breadth 100 : 53–39 or less) and branchlets sparingly pubescent with long internodes. South of the Thames, the common form has relatively broad leaves (ratio of length to breadth 100 : 54–63 or more) and the branchlets are densely pubescent and have shorter internodes. Through the intervening area, forms intermediate in character occur, and there is some intermingling of broad-leaved and narrow-leaved forms as well. Owing to the frequency with which this species is planted, it is not possible to decide whether or no the intermingling of the different forms is a natural phenomenon. Occasional narrow-leaved forms are found in the south and broad-leaved forms in the north, so that it is possible that the proportions of the various forms in the population change in a regular manner from north to south in much the same way as with the bridled and normal forms of the guillemot. There is no doubt, however, of the existence of the gradient in leaf-shape with its associated characters, and a somewhat similar gradient exists in at least one other British species of elm.

Intergrading between species due to hybridization, segregation and backcrossing is well known among plants and gives rise to difficulties for the

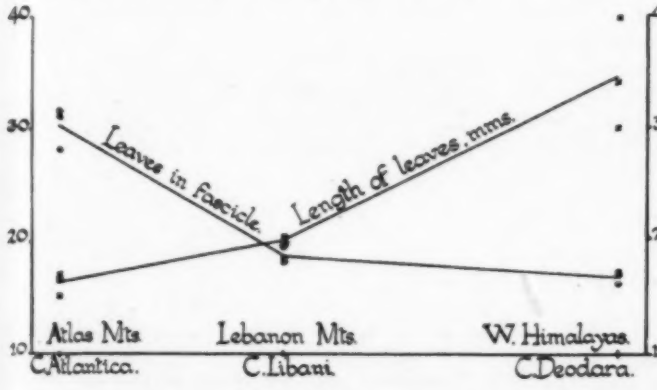

Fig. 1.

TOPOCLINES IN CEDRUS. MEAN CURVES FROM THREE TREES OF EACH FORM, GROWN AT KEW, SHOWING GRADIENTS IN MEAN NUMBER OF LEAVES PER ANNUAL FASCICLE ON SHORT SHOOTS AND MEAN LENGTH OF LEAVES OF SHORT SHOOTS IN MILLIMETRES.

taxonomist in such genera as Ulmus, Salix and Nothofagus. The intermediate forms normally have a random distribution in the area common to both parents, but they can be arranged in graded sequences analogous to naturally occurring clines by taking advantage of a suitable character, for example, leaf shape in Ulmus. For such an arrangement of hybrid forms, Melville[6] proposed the term *nothocline* and described a nothocline based on the variation of leaf shape in the numerous forms of the hybrid *U. glabra* Huds. × *U. Plotii* Druce. The primary need for a method of classifying hybrid swarms can thus be satisfied. The road is opened for attempts to correlate other characters, such as properties of the timber or resistance to disease, with the variable character on which the nothocline is based.

The arrangement of the individuals composing a species into clines enables the taxonomist to present the data of variation in a form in which it can readily be grasped. The sylviculturist may be able to draw useful conclusions from such data. Thus it is probable that glabrous forms of the Shagbark Hickory are more hardy than pubescent forms, while some at least of the intermediate-leaved forms of the Black Pine are the most desirable sylviculturally. If it proves feasible for the taxonomist to define ecoclines—a gradient related to conditions of the habitat—in woody species, some help may be afforded in the choice of the most suitable form for a particular site. A study of the European Larch on these lines would be useful. Until further work has been done on hybrids, the value of the nothocline remains problematical, though it seems probable that when linkage exists between morphological and sylvicultural characters, it will be revealed by the groupings arrived at in this type of classification. If this proves to be the case, the taxonomist may be able to indicate the best forms for propagation from the numerous wild forms in such hybrid swarms as those connecting the elms, *Ulmus glabra* and *U. Plotii*, and the common pedunculate and sessile oaks, *Quercus Robur* and *Q. petraea*.

[1] Langlet, O., *Svensk. Skogs. foren. Tidsk.*, 1–2 (1938).
[2] Kaiela, A., *Comm. Inst. Forest. Fenn.*, **26**, 1–445 (1938).
[3] Huxley, J., NATURE, **142**, 219 (1938).
[4] Gregor, J. W., *New Phytol.*, **38**, 321 (1939).
[5] Lindquist, B., *Acta Phytogeog. Suecica*, **4** (1932).
[6] Melville, R., *Proc. Linn. Soc.*, **151**, 157 (1939).

OBITUARIES

Prof. C. Białobrzeski

PROF. CZESŁAW BIAŁOBRZESKI, who was recently executed by the German authorities in Poland, came from a family of Polish country squires, settled in the Ukraine. He was born in 1879, when the Ukraine was a province of the Russian Empire. His earlier scientific and academic career was spent in the University of Kiev. Like other selected candidates for professorships he was sent abroad to continue his training. Langevin was the man to whom he chose to be attached. To Białobrzeski, he was the embodiment of the ideal physicist, the man uniting philosophical clarity and vigorous theoretical penetration with fine understanding of experimental work. Białobrzeski was all his life a faithful admirer of Langevin, in spite of a fundamental difference of views in everything but physics.

At Kiev, Białobrzeski held his first two appointments, as *Privat-docent* and assistant professor. After Smoluchowski's premature death, the University of Cracow chose Białobrzeski to be his successor. It was, however, not until a year or two after the end of the Polish-Bolshevik War that many Poles living in Soviet Russia were allowed to leave for Poland. Białobrzeski was among those repatriated. He was appointed professor at the University of Cracow; but a year later he answered the call to the capital. He settled in Warsaw, as professor of theoretical physics in the University, a position which he held until his death.

Theoretical physicist though he was by virtue of his appointment, he could never face being severed from a general physical laboratory. After some struggles, he had a laboratory of his own, well equipped and staffed with talented young people. The work of this laboratory is well known to every specialist in spectrography or dielectrics.

Białobrzeski published few papers. The subjects treated in his papers during his professorship in Warsaw were stellar radiation, absorption and diffusion of light, and dielectrics. His last papers were on cosmic ray bursts and on ionization in liquid dielectrics.

Białobrzeski was a very active member of the International Institute of Intellectual Co-operation, an organ of the League of Nations. Owing to his efforts, and undoubtedly to the keen interest he took in philosophical problems, about thirty leading theoretical physicists from Europe and America were invited to Warsaw by the Institute of Intellectual Co-operation for the purpose of discussing the philosophy of physics. This meeting took place on May 29–June 2, 1938, under the presidency of Prof. Białobrzeski.

He was a member of the Polish Academy of Sciences and several times president of the Polish Physical Society.

M. MATHISSON.

Dr. H. J. Walke

DR. HAROLD WALKE died in Liverpool on December 21 from the effects of an electrical shock received while working in the Physics Laboratory of the University. He was twenty-eight years of age.

Dr. Walke was educated at the Plymouth Corporation Grammar School and University College, Exeter. He early developed an interest in the growing subject of nuclear physics, and he published in quick succession a number of papers and notes which, while perhaps speculative and uncritical, revealed a fertile mind and a very fresh enthusiasm. In 1935 he was awarded a Commonwealth Fund fellowship and this gave him his first opportunity for experimental work in nuclear physics. He proceeded to the Radiation Laboratory, Berkeley, where he worked for two years under the direction of Prof. E. O. Lawrence. [Dr. Walke appears in the illustration of one of the Berkeley cyclotrons on p. 126 of this issue.] He published a number of excellent papers on artificial radioactivity produced in elements from potassium to vanadium.

Walke returned to Great Britain in 1937 to work in the Physics Laboratory, Liverpool, and in 1938 he was awarded an 1851 Exhibition senior studentship. He helped in the construction and operation of the cyclotron and, in addition, he continued his investigations into the activities induced in scandium, titanium and neighbouring elements, making some interesting discoveries in connexion with nuclear isomers and with the process of electron capture. He spent the summer of 1939 in Berkeley and returned in December with much work in hand and full of plans for the future. He had before him a career rich in promise, and his death at so early an age is a great loss to physics. Friendly and unassuming in manner, yet full of a vigorous and burning enthusiasm for his work, Walke was a delightful colleague. He is mourned by many friends both here and in the United States.

Mr. Douglas H. Baird, C.B.E.

DOUGLAS HERIOT BAIRD, managing director of Messrs. Baird and Tatlock (London), Ltd., died on January 3, at fifty-six years of age. The direction of such a business implies a wide knowledge of laboratory practice and of scientific progress. Mr. Baird was well endowed in these respects by virtue of education at Charterhouse, University of London and Karlsruhe (under Engler), and also by twenty-seven years' experience in the business, nineteen in succession to his father, the late Mr. Hugh Harper Baird, who founded it in 1879.

The business being world-wide, Mr. Baird travelled extensively—Canada, the United States, India, Ceylon, Burma, etc.—believing that requirements peculiar to overseas trade can only be properly satisfied by an intimate acquaintance with the local conditions. In these countries, and in those of Europe, Mr. Baird had many friends, and it is safe to say that he met at one time or the other almost every well-known director of a laboratory. During the War of 1914–18, Mr. Baird, besides running a poison gas filling factory, did important work in connexion with field laboratories. He designed the first mobile bacteriological laboratory sent out to France, and was responsible for the improvements in this, and the planning of other special laboratories for the use of the Army Medical Service of the Allies. He was created a Commander of the Order of the British Empire for his services.

After the War, Messrs. Baird and Tatlock became associated with Messrs. Hopkin and Williams, Ltd. A complete new series of the well-known catalogues were issued and the works at Walthamstow were rebuilt. During the past year a six-story annex to their warehouses in Cross Street, Hatton Garden, E.C. has been erected. One floor of the new building is occupied by laboratories of the company's own design and construction.

The work carried out in these laboratories comprises the testing of apparatus, chemicals and materials for laboratory construction; preparation of standard solutions, microscopic stains, indicators, and special reagents; research in chemical manufacturing methods; and the preparation of some of the rarer chemicals (chiefly organic). Special attention is being devoted to the last-named section, which has already turned out a large number of new products, some of which have not previously been obtainable in Great Britain.

Last year a new branch of the firm was opened in Calcutta to deal with increasing trade in the East, and in England the Hopkin and Williams' chemical side has been developed by building two research laboratories in Cross Street, and one semi-industrial research laboratory which is a liaison between the investigating laboratory and the work for elaboration of new processes.

Mr. Baird was chairman of the British Chemical Ware Manufacturers' Association, this year being his twelfth in office, and a member of the Standards Committee of the Institute of Chemistry, and of a number of other bodies associated with scientific affairs and apparatus.

WE regret to announce the following deaths:

Mr. J. E. Dowson, known for his work in connexion with producer gas, on January 3, aged ninety-five years.

Prof. L. Hopf, professor of applied mathematics in the University of Aachen until 1933, on December 21.

M. Max Laubeuf, member of the Section of the Applications of Science to Industry of the Paris Academy of Sciences, a pioneer in the development of the modern submarine, aged seventy-five years.

Mr. Reginald A. Smith, keeper of the Department of British and Medieval Antiquities in the British Museum during 1927–38 and director of the Society of Antiquaries, on January 18, aged sixty-six years.

NEWS AND VIEWS

Dr. C. H. Desch, F.R.S.

PERHAPS the outstanding characteristic of Dr. C. H. Desch, who retired from the post of superintendent of the Metallurgical Department of the National Physical Laboratory at the end of last year, was the astonishing—possibly unique—breadth and depth of his scientific knowledge and interests. Educated at the Finsbury Technical College, the University of Würzburg and University College, London, as a chemist, he entered the Metallurgical Department of the last institution in 1902. From 1909 until 1920 he was at the University and Royal Technical College, Glasgow. In 1920 he was elected to the chair of metallurgy in the University of Sheffield, a post which he held until 1931. Thus from 1902 until 1931 he was almost continuously engaged in metallurgical teaching and research.

Although primarily a metallographer, Dr. Desch's knowledge of the more practical aspects of metallurgy is wide, and his contributions to discussions are invariably welcomed by those engaged in industry. Alongside his metallurgical work, however, Dr. Desch has retained his interests in every branch of chemical advance; but the chemistry of cements and concrete, the intermetallic compounds, and the crystalline state in general have claimed his chief attention. The respect in which his scientific abilities have been held may be gauged by the variety of offices which he has filled. From 1926 until 1928 he was president of the Faraday Society; during the winter of 1931–32 George Fisher Baker lecturer in the University of Cornell, while at present he is president of the Institute of Metals and vice-president of the Iron and Steel Institute. Dr. Desch is now scientific adviser to the Iron and Steel Research Council.

Dr. C. Sykes

As chemistry was the avenue which led Dr. Desch into the field of metallurgy, so, in the case of Dr. C. Sykes, his successor as superintendent of the Metallurgical Department of the National Physical Laboratory, has physics functioned. After graduating in science in the University of Sheffield in 1925, Dr. Sykes spent one year carrying out research in physics under Prof. R. S. Milner. After obtaining the degree of M.Sc. in 1926, he entered the Metallurgical Department under Prof. Desch as a Metropolitan-Vickers research scholar. Two papers on the alloys of zirconium published in the *Journal of the Institute of Metals* in 1928 and 1929 appear to represent the first fruits of his work as a metallographer.

Since 1928, Dr. Sykes has been connected with the research organization of Messrs. Metropolitan-Vickers Electrical Co., Ltd., being engaged at first on work on high vacua, thermionic valves and X-ray tubes. About 1934, under the influence of Prof. W. L. Bragg, he began to publish in the *Proceedings of the Royal Society* and the *Journal of the Iron and Steel Institute*, and later in the *Proceedings of the Physical Society* and the *Journal of the Institute of Metals*, a remarkable series of papers on the super-lattice, the order-disorder change in β-brass and other alloys, on the supposed low-temperature critical points in iron and steel and on age-hardening. Some sixteen papers, all of real importance, represent the contribution which Dr. Sykes has made in little more than five years to that field of knowledge which is concerned with the physics of the metallic state.

Baron Richerand (1779–1840)

BARON BALTHASAR ANTHELME RICHERAND, a famous French surgeon, was born at Belley in the Ain Departement on February 4, 1779. He studied medicine in Paris, where he qualified in 1799 with a thesis on fractures of the neck of the femur, and two years later published his "Nouveaux Élémens de Physiologie", which met with a remarkable success and went through thirteen editions and was translated into seventeen foreign languages. In 1802 he was appointed assistant surgeon to the Hôpital Saint-Louis, where he later became surgeon-in-chief. In 1805 appeared his "Nosographie et Thérapeutique chirurgicales" in three volumes, of which the sixth edition was published in 1821. In 1807 he was made professor of surgical pathology in the Paris medical faculty, where he continued to lecture for more than thirty years.

In acknowledgment of the care which he had bestowed on the Russian and German wounded in 1814 in the Hôpital Saint-Louis, which had become converted into a huge ambulance, Richerand was made Commander of St. Anne and Knight of St. Wladimir by the Emperor of Russia and received the Military Order of Frederick from the Grand Duke of Baden and a gold medal from the King of Prussia. In 1824 he was appointed surgeon to Louis XVIII and in 1829 hereditary baron for his services to science and humanity. His minor works included "Des erreurs populaires relatives à la médecine" (1810) and "Histoire des progrès récents de la chirurgie" (1825). He also wrote notices of Bordeu, Cabanis, Brillat-Savarin, Ambroise Paré, etc., and a large number of articles in the "Dictionnaire des sciences médicales", *Mémoires de la société d'émulation*, *Bulletin de la Société philomathique*, *etc.* He died on January 23, 1840. A posthumous honour was paid to him in 1851 when the Avenue Saint-Louis was renamed after him.

Utilization of Scientific Research during War

IN the House of Lords on January 18, Lord Strabolgi asked the Government questions on the methods being adopted to examine 'war inventions',

(*Continued on page* 143)

NATURE

SUPPLEMENT

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SHORT REVIEWS

Biology

The General Aspects of the Vegetation of Europe

By Marietta Pallis. Pp. iv+66. (London: Taylor and Francis, Ltd., 1939.) 3*s*. 6*d*. net.

IN this essay, Miss Pallis endeavours to assess the various factors which have determined the character of the existing vegetation of Europe. She naturally places in the foreground the climatic factors, particularly the rainfall, which according to Schimper governs the development of woodland and grassland respectively. For Europe, with its comparatively abundant rainfall, woodland should be dominant. But this dominant vegetation which Miss Pallis calls primitive has been considerably modified by the action of animals and man, both in historic and in prehistoric times. Miss Pallis thinks that Schimper did not appreciate sufficiently the enormous effect of such action, to which he only refers incidentally. The fact that much of the present vegetation of Europe is of a secondary or degenerate type caused by animal and human interference seems to the author to be of far-reaching importance.

Farrow's experiments on the vegetation of the Breckland have demonstrated the modifying effect of rabbits, and Miss Pallis in her essay directs attention to many other instances of the change in vegetation produced by man and domestic animals, particularly goats, in other parts of Europe—Thessaly and Greece being especially chosen as examples.

But apart from what is going on at present, Miss Pallis indicates that such changes may have been occurring for an indefinite length of time, long before human interference occurred. The disappearance of the forest covering the greater part of Europe began gradually, she believes, with the appearance of herbivorous animals and gained in speed towards the end of the Tertiary period, when the grazing horse took the place of the browsing horse. The appearance of these horses coincides with the progressively falling percentages given by Mrs. Reid and Miss Chandler for the woody plants of the Tertiary.

In a table at the end of the publication, Miss Pallis sets out clearly some of the facts on which she bases her conclusions. Her essay, in which a great many facts have been gathered together, both from her own observations and from those of others, gives much food for reflection, and should be carefully studied by all ecologists and plant geographers.

Wild Chorus

Written and illustrated by Peter Scott. Pp. x+120+68 plates. (London: *Country Life*, Ltd., 1939.) 21*s*. net.

THE pictures take the stage in this attractive book, and the text makes an appropriate background. The writing is simple and direct, and whether the author takes us after geese in the mud-flats of the East Anglian coast, on the plains of Hortobagy, on the Black Sea or in Persia, or merely describes the return of Annabel or Barnacle Bill, or the punting risks encountered at the railway bridge, he manages always to convey a sense of adventure and a feeling of enthusiasm in his exploits.

Few artists have been able to catch the attitudes and colour patterns of birds without losing spontaneity by paying too great attention to feathers; but Peter Scott has this gift. He is too familiar with his ducks and geese to miss their particularities, and his fine appreciation of design and of the effect of masses of light and shade are strikingly shown in such pictures as "Pink feet paired", "Blue Sky and Snow Geese", and "Four Teal". The colouring varies considerably in quality: among the most successful are "La Toilette", a picture of two pink-footed geese upon wet sand, "Garganeys in Spring", and the subdued yellows and greys of "Geese moving from Stubble to Potatoes". But in some, while the action and grouping of the birds themselves are beyond criticism, the treatment of clouds and water is harsh

and the colours strong even to hardness. There are two fine sepia reproductions of water-colour drawings, flamingoes and Caspian pelicans, and the quality is so delicate that one could have wished that a coloured plate had been spared for a water-colour.

An odd mis-spacing occurs in the legend of the plate facing p. 10, "BRENT GEESE COMING OFF THE ZO STERA", which suggests an exotic lake rather than a common water-weed.

To anyone who delights in lively narrative and in the colouring, action and groupings of geese and ducks in the air or on water or land, this work will afford great pleasure. JAMES RITCHIE.

A Book of Roses

By J. Ramsbottom. (The King Penguin Books.) Pp. 30+16 plates. (Harmondsworth: Penguin Books, Ltd., 1939.) 1*s.* net.

THIS charming little book reproduces most excellently in octavo size sixteen coloured plates by that master of botanical portraiture Pierre Joseph Redouté, whose magnificent three-volume work "Les Roses" was published in thirty parts between 1817 and 1824. In addition to the exquisite reproductions, there is for each of the roses figured a short account giving botanical and horticultural information.

Of Redouté himself there is a good account. His career is full of interest. Shortly before the French revolution he came over to England to learn the English methods of stipple engraving not then used in France.

The major part of the text of the "Book of Roses" is devoted to the history of this queen of flowers. The earliest known European representation of the rose is found in the House of Frescoes at Knossos, dating from the middle of the sixteenth century B.C. The ancient coins of Rhodes had figures of roses, which flower gave the name to the island. Herodotus and Theophrastus, the father of botany, both give accounts of the rose. From these early representations and descriptions of the rose through Roman and medieval times to the present day, Lr. Ramsbottom follows up carefully and delightfully the history of the rose. His very readable and informing text seems to refute a passage of Walter de la Mare:

> . . . . . "No man knows
> Through what wild centuries
> Roves back the rose".

The "Book of Roses" is sure of a warm welcome, and the publishers are to be congratulated on their production of this most charming little book.

The World of Plant Life

By Prof. Clarence J. Hylander. Pp. xxii+722. (New York: The Macmillan Company, 1939.) 32*s.* 6*d.* net.

PROF. HYLANDER, in his preface to this volume, says that it was "planned and written with the specific purpose of making the layman familiar with a few of the interesting plants, both native and introduced, which are found in the United States". He has purposely avoided using unnecessary technical terms, and has written throughout in a style that will appeal to the non-scientific reader. Indeed, in some instances he is perhaps too lax in his statements, as when he says in his preface that "Gardening is a fundamental instinct", a view that few psychologists would support!

After an introductory section on the whole plant kingdom, Prof. Hylander works step by step through the various groups, commencing with bacteria, and following more or less the system of Engler. As end-papers there are phylogenetic 'trees' showing the supposed lines of plant descent from fission plants to palms and pinks. It is perhaps a pity to include these in a popular work, as many readers will assume that such trees rest on a firmer foundation than is actually the case. This is especially so if Engler's system is used, as Engler himself was definitely sceptical regarding its phylogenetic basis.

Under each family Prof. Hylander mentions a number of genera and species of special interest to American readers, and the information he gives will undoubtedly provide a useful scientific background for the study of American vegetation, both native and introduced.

The illustrations are excellent, and special mention should be made of the attractive silhouettes at the head of each part.

Looking at Life

An Introduction to Biology. By A. M. S. Clark and G. Buckland Smith. Pp. xvi+224. (London: J. M. Dent and Sons, Ltd., 1939.) 2*s.* 6*d.*

THE cinema has now come to be regarded as a valuable tool in the construction of a biological education. The visual images that the viewer carries away with him are necessarily more stimulating and dynamic than the static photographs of text-books. But the transitory character of a film-showing has a disadvantage in that if a mistake in visual memory is made by a pupil it may well persist, so that the aim of the authors of "Looking at Life" in supplying an elementary book which could be used as a complement to the already available biological films is admirable.

Unfortunately, the text of the book contains little more than a potted version of the more rigid university botany and zoology courses and is scarcely suitable to serve as a first course in biology. Animal and plant types are described in a manner completely unrelated to any local environmental conditions, so that a syllabus based on this book would be, at least with regard to the animals, almost entirely theoretical, or would have to rely largely upon museum specimens. Better use of already existing films would have been made if the framework had been constructed around representative types of freshwater and terrestrial forms which are likely to be available. The text itself is a strange mixture of clarity and obscurantism, while the complete omission of gymnosperms is peculiar in a book where all the other main plant phyla are described.

CHEMISTRY

Electrochemistry and Electrochemical Analysis

A Theoretical and Practical Treatise for Students and Analysts. By Dr. Henry J. S. Sand. Vol. 1: Electrochemical Theory. Pp. viii+134. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1939.) 4*s.* 6*d.* net.

THE preface states that this, the first of two volumes, deals with general principles, the second volume being planned to be a guide to modern methods of gravimetric electroanalysis. The present volume provides a clear and sound introduction to electrochemistry and covers all the theoretical matters which will arise in the practical part, some of which are not very well explained in other books. The section on transport numbers is good and the concentration changes at electrodes dealt with in Chapter vii are clearly explained. The modern theory of electrolytes is briefly yet adequately dealt with, but it is unfortunate that both the equations given on p. 64 are incorrectly printed. Some expressions are peculiar; for example, on p. 57 the 'valency of a reaction' is mentioned, and the system of numbering of the equations is sometimes rather puzzling. The book will be particularly useful to analysts who have to use the electroanalytical methods and have not kept up to date in electrochemical theory, whilst all students will welcome the concise and clear way in which the principles of the subject are discussed.

Aids to Organic Chemistry

By Stanley F. Smith. (Students' Aids Series.) Second edition. Pp. viii+120. (London: Baillière, Tindall and Cox, 1939.) 3*s.* 6*d.*

THE second edition of this useful little work has been revised, the sections on sugars and complex aromatic compounds have been re-written to bring them up to date and give the modern ideas on their structural formulæ, and the index has been enlarged. The author, however, has been careful not to expand the text so as to change the character of the book. The volume provides a concise summary of organic chemistry which will be very useful to medical students in the preparation and revision of the subject, and it is a useful supplement to text-books which deal with the topics in more detail.

The Economics of Chemical Industries

By Dr. Edward H. Hempel. Pp. ix+259. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 15*s.* net.

IT is regarded at least as important to be able to sell an article as to make it: indeed the salesmen are more highly remunerated than the technical workers. Whilst personality is the greatest asset for a salesman, there is growing up a science of salesmanship and management which is evidenced by the increasing number of books dealing with various aspects of the subject.

This particular one seeks to portray the characteristic background and the economics common to the American chemical industries. It is very informative and will be of great value in its country of origin and of interest elsewhere to firms which have business connexions with the American chemical industry. It deals largely with legislation, foreign chemical trade, and financial policies, and contains a considerable amount of statistical matter. A similar volume based on British customs would have wide appeal.

ENGINEERING

(1) Lehrbuch der Hochfrequenztechnik

Von Dr. Fritz Vilbig. Zweite verbesserte und erweiterte Auflage. Pp. xxviii+1019. 35.80 gold marks.

(2) Schrifttumsverzeichnis zum Lehrbuch der Hochfrequenztechnik

Von Dr. Fritz Vilbig. Zweite verbesserte und erweiterte Auflage. Pp. iv+172. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 8 gold marks.

THE publication of Dr. F. Vilbig's monumental text-book on high-frequency phenomena two years ago provoked expressions of general and well-merited approval, for it was clear that its author had successfully attempted the difficult task of surveying, in up-to-date fashion, a field already extensive and yet expanding. In particular was his effort commended for the judicious balance of his selection of material, old and new. Two years is a long time in wireless history, so that it is not at all surprising that Dr. Vilbig has already been obliged to undertake the preparation of a second edition (1) of his book. The changes made are naturally mainly by way of additions, the chapters being expanded on the average by a fifty per cent increase of text, though naturally the expansion is relatively greater in the case of such swiftly developing subjects as the study of wave propagation and television. An entirely new chapter on modern acoustics has, however, been added at the end of the book.

In Dr. Vilbig's first edition a most comprehensive and up-to-date bibliography of books and original papers occupied no less than a hundred pages. In view of the expansion of the main text in the second edition, it has become necessary to publish this bibliography as a separate volume (2), which is, of course, correspondingly enlarged and brought up to date.

Radio Interference Suppression

By G. W. Ingram. Pp. viii+154. (London: The *Electrical Review*, Ltd., 1939.) 5*s.* net.

IT is not often that one branch of applied science reacts so unfavourably on another branch, and the difficulties which have arisen from the interference from power circuits and apparatus in the prevailing types of radio-receivers were scarcely anticipated. The problem assumed international magnitude, and has only within the last few years been brought down to a qualitative basis. Meanwhile the British Post Office has been investigating and advising on tens of thousands of cases per annum, and it is to them that we owe the idea that

the interfering radio currents travel along power and other mains longitudinally, that is, along the wires in parallel; indeed, the impedance to earth of such mains may be megohms, thus conserving the disturbing energy. The variegated field has now been sorted, and a very complete guide offered by the present author, whose firm has been in the forefront, both in theory and practice, of interference suppression. In principle the methods are simple, the application of condensers to earth, with or without appropriate chokes, being most general; the economic design of units and their proper location, however, requires systematic thought. Much of the author's information is usefully tabulated. L. E. C. H.

Applied Acoustics

By Dr. Harry F. Olson and Frank Massa. Second edition. Pp. xviii+494. (London: Constable and Co., Ltd., 1939.) 25*s*. net.

AMONG the most important applications of science in commercial engineering is sound-films, and the Radio Corporation of America, which has the services of the authors in high executive capacity, has always shown initiative and independence of the Western Electric, its major competitor, in improving sound recording and reproduction both as a whole and on the scale demanded by cinema-goers. The new edition is a somewhat expanded version of the first edition, with the necessary sections brought up to date. The text is most readable and remains the best summary of technical applications of what was long considered to be an academic scientific subject. The side-issues are many, including the measurement of noise, the control of transmission of sound vibrations through building structure, much physiological acoustics, and sound-signalling. The print and diagrams are both excellent. L. E. C. H.

Geology

Outlines of Historical Geology

By Prof. Charles Schuchert and Prof. Carl O. Dunbar. Third edition, entirely rewritten. Pp. v+241. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 12*s*. 6*d*. net.

THIS book provides a summary of geological history; but it must be stated at once that this history has special reference to North America, since mention—and that brief—is made of only a few non-American topics or examples. It is not intended for the specialist, its aim being to provide a short general survey of earth-history. As the authors say, their intention is to bring into relief the high lights of this history, and this they certainly succeed in doing.

The story is presented in four parts, the first dealing with the nature of the evidence, the second with the physical history and the third with the history of life. The sections concerned with the later episodes of geological history have deliberately been made fuller than usual in a book of this size, this added detail leading up to the fourth part of the book, in which man's geological history is considered. The account of the evolution of mammals, including man, is especially well done. As usual in American text-books, the illustrations are abundant and mostly excellent; a few mistakes have been noted—for example, there are no Tertiary lavas in the Orkneys.

This is an excellent book for a geology student desiring a summary of North American historical geology, or for the general reader in search of a refreshing but authoritative account of the marvellous pageant of life revealed by palæontology.

Geology for Engineers

By Brig.-General R. F. Sorsbie. New edition. Pp. xxii+348. (London: G. Bell and Sons, Ltd., 1938.) 12*s*. 6*d*. net.

THE first edition of this book was published in 1911, and while the same general arrangement is retained in the new volume, the former chapters on historical geology have been omitted and the section on applied geology extended, so that it now forms nearly two-thirds of the book. No new illustrations are used, all the diagrams being taken from the old edition. Much material is quoted direct from other authors, and modern treatment of subjects such as clays and soils is lacking. The bibliographies which are given with various chapters would be improved by the inclusion of fuller details and dates; the titles of works published more than sixty years ago could well be replaced by those of more recent text-books.

Mathematics

Elliptic and Hyper-elliptic Integrals and Allied Theory

By the late W. R. Westropp Roberts. Pp. viii+311. (Cambridge: At the University Press, 1938.) 12*s*. 6*d*. net.

WILLIAM RALPH WESTROPP ROBERTS was the eldest son of the senior fellow of Trinity College, Dublin, and after a brilliant career as a student in which he gained most of the important prizes in the Mathematical School, he was elected to a fellowship at his father's college in 1882. During the remainder of his life he made many noteworthy contributions to mathematics and in later years planned to publish a work embodying his researches. The present volume is the outcome of that aim, but unfortunately, the author did not live to complete his work.

The text is divided into six chapters, the first of which is devoted to some necessary theorems in algebra. Then follows a lucid discussion of some elementary integrals upon which the more general integral is shown to depend. In this chapter, a very interesting and valuable analysis is given of the function $R(z, n) \equiv d\chi/dz - d\chi/dn$, where χ denotes $A_0\{f(z) - f(n)\}/(z - n)$, which is essential to the development of the subsequent theory. Chapter iii is devoted to algebraic equivalents and Abelian transcendents. The text then passes to Abelian or hyper-elliptic integrals, in which there is a clear

investigation of their periodicity. Finally, Chapters v and vi are concerned with the particular cases in which $m = 2$, giving rise to elliptic integrals and functions, and $m = 3$ of the general polynomial $f(z)$ which occurs under the square root in the denominator of the integrand. Each chapter closes with a set of examples for the student's use, and among these may be found some important theorems.

It is evident that the work is not complete as there are several references to Chapter vii and the figures contained therein, but this chapter was never written nor were the diagrams drawn. In spite of this, however, the book is not only a striking essay in mathematical analysis, but is also a notable contribution to the subject. F. G. W. B.

Étude critique de la notion de collectif

Par Prof. Jean Ville. (Monographies des probabilités, Fascicule 3.) Pp. iv+144. (Paris : Gauthier-Villars, 1939.) 75 francs.

THERE are many ways, none altogether satisfactory, of defining probability, but roughly speaking, these fall in two groups, namely, those based upon the 'equally-likely' concept of Laplace, and those based on the concept of frequency. In recent years the frequency method has been greatly developed by von Mises, who introduced the notion of a *collective*. This is defined as a mass phenomenon or an unlimited sequence of observations such that the relative frequency of a particular attribute tends to a fixed limit unaffected by any place selection or gambling system. The probability of the attribute in the given collective is then defined as this limit. It is claimed that this treatment avoids the logical difficulties inherent in Laplace's method.

M. Ville makes a careful analysis of the ideas of von Mises, and also of those of Reichenbach, Popper, Copeland and Wald, who have put forward closely related theories. The conclusion is that the idea of a collective, though roughly what is needed, is too rigid. In particular the use of the word limit, in the strict mathematical sense, either leads to results which are inconsistent with themselves, or at best necessitates a set of artificial restrictions which are really alien to the nature of the problem. A satisfactory definition of probability has not yet been found. H. T. H. P.

Orthogonal Polynomials

By Prof. Gabor Szegö. (American Mathematical Society, Colloquium Publications, Vol. 23.) Pp. ix+401. (New York : American Mathematical Society, 1939.) 6 dollars.

ORTHOGONAL polynomials were first studied in connexion with a certain type of continued fractions, bearing the name of Stieltjes. They are closely related to problems of interpolation and mechanical integration, and recently have come into prominence in connexion with mathematical statistics and quantum mechanics. They are also connected with trigonometric, hypergeometric, Bessel, and elliptic functions, and occasionally occur in the theories of differential and integral equations. The present book is the first in the English language on the subject, and indeed the first extensive treatment of the subject in any language. It deals both with special orthogonal polynomials, such as those of Jacobi, Laguerre, and Hermite, and also with the general theory. In particular, there is an account of recent investigations of the distributions of the zeros, of asymptotic representations, of expansion problems, and of certain questions of interpolation and mechanical integration. Some of the results not previously published are due to the author himself. The book concludes with a set of sixty problems, a bibliography, and an index. H. T. H. P.

Mathematical Tables

Vol. 7 : The Probability Integral. By W. F. Sheppard. Completed and edited by the Committee for the Calculation of Mathematical Tables. (Published for the British Association for the Advancement of Science.) Pp. xi+34. (London : Cambridge University Press, 1939.) 8*s*. 6*d*. net.

THESE tables are concerned with the values, from $x = 0$ to $x = 10$, of the functions

$$F(x) = \frac{1}{\sqrt{(2\pi)}}\int_x^\infty \exp(-\tfrac{1}{2}t^2)dt,\ z_x = \frac{1}{\sqrt{(2\pi)}}\exp(-\tfrac{1}{2}x^2).$$

Tables I and II give the ratio $F(x) : z_x$ at intervals 0·01 and 0·1 for x and to 12 and 24 decimal places respectively.

The remaining four tables give natural and common logarithms of $F(x)$. Interpolation is facilitated by the tabulation of derivatives or differences.

The Committee's amplification of Sheppard's work consisted in the completion of Table I and the computation of Table VI.

"The Committee believe that the completion and publication of his tables of the probability integral constitute just that memorial to Sheppard's unsurpassed labours in the field of Mathematical Statistics, which he would himself most greatly have appreciated."

Meteorology

The Drama of Weather

By Sir Napier Shaw. Second edition. Pp. xiv+307. (Cambridge : At the University Press, 1939.) 10*s*. 6*d*. net.

IT is evidence of the growing interest in meteorology that this book should within five years have been reprinted and have now reached a second edition, enlarged by the addition of two chapters with the titles "Where our Rain Comes From" and "Chapter and Verse for Weather in Relation to Agriculture".

The added chapters carry on the happy traditions of the previous portion, the fresh and picturesque language, the concrete as opposed to the abstract statement, and the use of ingenious diagrams containing data that other writers have not attempted to embody. Such diagrams bring into prominence facts which might remain unnoticed if their discovery depended on a severe study of columns of figures ; for example, Fig. 93 (p. 258) reveals at

once that in the British Isles places fully exposed to the west winds have much heavier rain in winter than in summer, while on the east coast rainfall is more evenly distributed through the year. The author loves a paradox and a note of interrogation regarding widely prevalent ideas. In the first of the new chapters he is certainly successful in stimulating thought when he defends the idea that the pressure distribution is produced by the winds, not vice versa.

The chapter on agriculture contains a number of interesting diagrams. It includes a discussion of the calendar, though it makes no mention of the widely supported World Calendar in which the year consists of four quarters each of three months or 91 days, beginning on a Sunday; in it the 365th day is inserted between December and January.

The book is strongly recommended, to meteorological specialists and laymen alike, for its wide range of appeal, historical and artistic as well as scientific. G. T. W.

Meteorology for Aviators

By Dr. R. C. Sutcliffe. (Air Ministry: Meteorological Office.) (M.O. 432: A.P. 1699.) Pp. xiv+278+27 plates. (London: H.M. Stationery Office, 1939.) 7*s*. 6*d*. net.

THIS publication deals with those aspects of meteorology which are of importance in aviation; but as most of the subject-matter is the common ground of meteorology, the book will appeal to many who are not directly concerned with aviation. It is intended primarily to cover the meteorological syllabuses laid down for the various air navigators' and pilots' licences, and so supplies a long-felt want.

To some extent the information is presented in an encyclopædic, albeit very readable, form, and in this respect the volume recalls the very serviceable Admiralty Weather Manual. The statements that severe hail is "very rare" in the British Isles and that "for really spectacular hailstorms it is necessary to go to tropical and sub-tropical regions" perhaps call for some revision. Hail is a veritable scourge in many parts of central and southern Europe, and in France an elaborate organization for the defence of the vineyards has been in existence for several years (see *Geog. J.*, December 1939, p. 509). L. C. W. B.

Psychology

Psychological Foundations of Personality

A Guide for Students and Teachers. By Prof. Louis P. Thorpe. (McGraw-Hill Series in Education.) Pp. xvi+602. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 21*s*.

THE author is assistant professor of education in the University of Southern California. His book is one of many on personality and compares very favourably with most.

Prof. Thorpe has wisely left out the usual string of illustrative cases which contrive to spoil most books on the subject and are usually a complete waste of time to read. Most readers have ample clinical material of their own; to those who have not, cases usually add confusion and a certain superficiality.

After reading books on personality, the present reviewer always wonders, Is the world any better for all this? Time alone will show.

The Family meets the Depression

A Study of a Group of Highly Selected Families. By Prof. Winona L. Morgan. (Institute of Child Welfare, Monograph No. 19.) Pp. x+126. (Minneapolis: University of Minnesota Press; London: Oxford University Press, 1939.) 9*s*. net.

THIS is a study of the economic stability and psychological adjustments of several hundred families drawn from different parts of the United States. A prior study of the same families was carried out in 1927 and the present investigation was planned with the purpose of discovering any effects due to the intervening five-year period of economic depression (1927–1932). A comparison is made between the earlier and later results. The sample of families was relatively homogeneous as regards socio-economic status. The general outcome, according to the author, seems to favour the family as a social institution.

Biographies of Child Development

The Mental Growth Careers of Eighty-four Infants and Children; a Ten-Year Study from the Clinic of Child Development at Yale University. Part 1, by Dr. Arnold Gesell; Part 2, by Dr. Catherine S. Amatruda, Dr. Burton M. Castner, Dr. Helen Thompson. Pp. xvii+328. (London: Hamish Hamilton, Ltd., 1939.) 15*s*.

GESELL'S valuable contributions to the field of mental growth and developmental norms in infancy need no introduction. The present work by Gesell and three associates is the result of cumulative observations carried out over a period of ten years, on eighty-four infants and children. A wide diversity of cases, mostly typical and touching many aspects of child psychology, is to be found in this study. The primary aim of the authors is to assess the prognostic value of the normative criteria used at the Yale Clinic of Child Development. The book is carefully written and may be recommended to psychologists in Great Britain.

Psychopathic States

By Prof. D. K. Henderson. (Thomas W. Salmon Memorial Lectures.) Pp. 178. (London: Chapman and Hall, Ltd., 1939.) 8*s*. 6*d*. net.

THE Salmon Memorial Lectures for 1938 were delivered by Prof. D. K. Henderson of Edinburgh. They deal in a very fascinating manner with the problem presented by the psychopath and his many bizarre disorders of conduct.

It is difficult to make the lay mind understand that these mental disorders can occur and usually

do occur in individuals who are of normal intelligence. They are disorders of conduct and as such are very difficult to deal with; further the law is frequently no help and the individual too cunning to help society, often his greatest enemy.

PHYSICS

Cosmic Rays and Mesotrons

By Lt. H. J. J. Braddick. (Cambridge Physical Tracts.) Pp. x+68. (Cambridge: At the University Press, 1939.) 5*s*. net.

IN a subject that has been developing as rapidly as that of cosmic rays, the writing of books is a difficult and often not very fruitful task. Anything in the nature of a treatise is as yet impossible, and treatment of special branches may be out of date by the time a book can be prepared and published. But special circumstances have enabled the author of this work to avoid this pitfall. The small size of the Cambridge Physical Tracts, in this case only 65 pages, calls for extreme condensation, but makes possible rapid publication. Revision has been made to June 1939, so the book may be considered as up to date as is humanly possible. The author does not pretend to cover completely the whole subject. The first part is a useful digest of the more significant experimental results, while the second is a review, from the theoretical side, of the passage of cosmic rays through matter, and in particular of the shower phenomenon. One chapter is devoted to the mesotron, and contains the evidence for assuming the existence of a new particle of mass intermediate between the proton and the electron. There is also a short discussion of its theoretical implications.

A selected bibliography will enable the reader to pursue the subject more deeply.

Absolutkolorimetrie

Von Prof. Dr. A. Thiel. (Arbeitsmethoden der modernen Naturwissenschaften.) Pp. xv+215. (Berlin: Walter de Gruyter und Co., 1939.) 10.80 gold marks.

PROF. THIEL is to be congratulated on the clear and comprehensive account which he has given of his work on the application of colorimetry, which has enabled him to elaborate a technique whereby many inorganic and organic substances can be quantitatively determined optically with an accuracy not before achieved by this method of analysis.

The book is divided into two parts, in the first of which is explained the general principles of colorimetry, the technique used and the apparatus employed. The second section gives details of the practical application of Thiel's method of analysis for the quantitative determination of both inorganic substances and of many organic compounds which are of special interest to biologists and medical workers, notably the vitamins and hormones.

The book is a welcome addition to the essential text-books of chemical and biological laboratories.

A Text Book on Light

By Dr. A. W. Barton. Pp. x+426+6 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1939.) 8*s*.

THERE are several features of interest in this new book on light by the headmaster of King Edward VII School, Sheffield. The method of presentation is historical, but only "in the sense that the discovery of facts and the development of ideas is presented as they occur historically". There is an unusually good account of Newton's experiments and of his deductions from the facts of observation. It is then pointed out how the mass of evidence grows until one theory fails and another has to take its place. The author adopts the convention as to signs which counts distances measured from the pole of a refracting surface in the *same* direction as the initial direction of the light positive, and the diagrams in the book are drawn with the incident light travelling from left to right so as to give agreement with the usual convention of co-ordinate geometry. Special mention must be made of the beautiful photographs supplied for the plates by Mr. J. W. Cottingham of Barnsley Grammar School and Dr. J. W. Mitchell of Repton School.

A Text Book of Applied Hydraulics

By Prof. Herbert Addison. Second edition, revised and enlarged. Pp. xii+435. (London: Chapman and Hall, Ltd., 1938.) 21*s*. net.

THE issue of a second edition of Prof. Addison's manual is evidence that it has served the purpose which he had in view in writing more especially for "those whose work is not directly connected with hydraulics, but who require to be kept in touch with the main outlines of hydraulic practice".

The new edition makes good a deficiency in the earlier issue in that it contains a useful bibliography of the works to which allusion is made in the text, and there is an additional chapter devoted to propeller and screw pumps. A commendable feature is the number of examples with solutions, numbering 125 and occupying 73 pages. These should be helpful to the teacher, as well as to the student reader who may be working without oral help.

The author is careful to point out that hydraulic formulæ, purporting to be based on identical data, can, and often do, yield different results. This warning is particularly necessary in the case of students and young engineers, who are apt to imagine that a formula is an infallible, as well as a labour-saving, device.

Theoretical Mechanics

A Vectorial Treatment. By Prof. Carl Jenness Coe. Pp. xiii+555. (New York: The Macmillan Company, 1938.) 21*s*. net.

IN this book on theoretical mechanics, Prof. Coe, of the University of Michigan, has adopted from the outset the methods and notation of vector analysis, which provide a language common to all the branches of mathematical physics. His aim has been to present an introduction to classical mechanics, and through

it to mathematical physics, which shall make clear the postulates on which they rest, and at the same time to explain and apply the basic principles of the vector method. He claims that this approach has proved its value in teaching and enables the student to use vector analysis in his later work. The book, which may be confidently recommended, contains sufficient material for an introductory and an advanced course.

Technology

Principles of Mechanism

By F. Dyson. Third edition. Pp. vii+364. (London: Oxford University Press, 1939.) 12*s*. net.

FIRST published in 1928 and now already appearing in its third edition, this text-book has fully proved its adequacy for the purpose for which it was written. This was to present the fundamental principles which apply to the moving parts of machines in a sufficiently comprehensive manner to satisfy the requirements of those studying for the engineering degree or for the examinations of the engineering institutions. The line taken by the author was to develop the theory of machines in logical sequence from the well-known principles of mechanics, of which a summary was given in the first chapters. That the third edition exhibits no substantial change in the structure of the book, beyond a number of additions made necessary by the increasing scope of the examination syllabuses, is evidence of the sufficiency of this method of presentation.

The additions fall into two classes, the first of which includes a description, explanation and analysis of the pre-selective epicyclic gear-box. Such an example requires very careful treatment, as each operative gear is a combination of simple mechanisms, and here the method of analysis has been set out in full detail, thus giving the student a lead which should enable him to deal successfully with any other complication of epicyclic gears. The second class of additions comprises several of the more difficult examples of the determination of the acceleration of points in mechanisms. There is an acceleration diagram for a quick-return motion fully explained in the appendix, and as this case is more difficult than that of the simple link mechanisms, this constitutes a very welcome piece of extra information for the student. The exact mathematical analysis of the acceleration of a piston and that of a follower in contact with a cam face of straight or circular outline are also new. What the student will greatly value is the clear, direct, and unambiguous style in which the author expresses himself.

Colour Cinematography

By Major Adrian Bernard Klein. Second edition, revised and enlarged. Pp. xxii+463+42 plates. (London: Chapman and Hall, Ltd., 1939.) 30*s*. net.

IN the previous edition Major Klein gave us, in addition to much information and informed criticism on all aspects of motion pictures in colour, first-hand knowledge of the Gasparcolor system. He has since migrated to the Dufay-Chromex concern and now treats us with details of the Dufay system, the commercial difficulties, and the brilliant way in which they have been met. Perhaps we shall not get the full story of the most used colour process until he is acquired by Technicolor. The text remains a most useful historical summary of the subject, a guide to the present application of scientific principles in a difficult branch of commercial engineering, and a severe criticism of usage. Of particular mention are the Dufay printing and mitigation of moiré, the treatment of beam-splitter cameras, the development of suitable light-sources, and the calculation of filter transmissions. We wish other publishers would emulate the gay colours of the binding.

L. E. C. H.

Wissenschaftliche Photographie

Eine Einführung in Theorie und Praxis. Von Prof. Dr. E. v. Angerer. Zweite gänzlich neubearbeitete Auflage. Pp. vii+211+3 plates. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 13.80 gold marks.

THIS volume is addressed to the scientific worker who uses photography as a tool rather than to the specialist in photographic technique or theory. Thus the book is written in a style easily understood by anyone with a rudimentary knowledge of physics and chemistry. It describes the nature of the photographic emulsion, its sensitometry and treatment after exposure in considerable detail. The production of the positive print, colour photography and the camera itself are only described to an extent sufficient to make the book complete. This is as it should be, for the main concern of such a book is to guide the experimenter to find the best possible conditions for obtaining the most satisfactory negative. It is, however, more than a photographic manual, for it contains much interesting information for the reader with only a casual acquaintance with photographic methods.

H. W. M.

The Art of Soaring Flight

By Wolf Hirth. Translated from the German by Naomi Heron Maxwell. Pp. 214. (London: *Sailplane and Glider*, 1938.) 5*s*.

AN English translation of the work of Wolf Hirth, one of the pioneers of soaring flight, was called for by reason of the rapid strides made in the art during recent years in Great Britain and America.

The translator says: "No student of soaring flight can ever hope to achieve success without an understanding of certain meteorological phenomena which are clearly explained in this book, and I feel that the reader will find every page both stimulating and interesting". There are accounts of storm-flying and interesting information on the obstruction of fronts by mountain ranges and the like. Sailing in the air, to a greater extent even than on water, raises a host of meteorological questions which would otherwise never be thought of.

L. C. W. B.

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to secure co-ordination between the scientific departments of the fighting Services and the Ministry of Supply, and the extent of the co-operation between the British and French Governments in these matters. Lord Strabolgi said he did not wish his remarks to be interpreted as hostile to the Government, and he paid tribute to the strength of the recently appointed Advisory Council of Scientific Research and Technical Development. The reply elicited from Lord Chatfield, Minister for the Co-ordination of Defence, was informative and important as indicating the extent to which the knowledge and services of men of science are being utilized.

Lord Chatfield paid a tribute to the value of scientific research to the Services. The existing establishments were in the main created after the War of 1914–18 or during its later years. They now include many of the leading men of science in the country, either in a working or advisory capacity. He referred to eight research laboratories under the Department of Scientific and Industrial Research, and said: "Generally it is perfectly correct to say that the scientific talent of this country is fully mobilized to its fullest advantage and runs into a very large number of scientists, to be numbered rather in thousands than in hundreds." There is no central organization for dealing with inventions, which actually constitute only a small part of the scientific work in progress. Each Service department and the Air Raids Department of the Ministry of Home Security has its own organization for dealing with inventions, and there is constant consultation between these bodies.

Dealing with the exchange of scientific knowledge between the British and French Governments, Lord Chatfield said that co-operation had begun before the outbreak of war, and that there is now "complete exchange of scientific information". Members of the scientific organizations of the two countries are working in each other's establishments. Further efforts are being made, however, to extend the present liaison. Steps are under consideration to safeguard the interest of inventors, and it is likely that machinery similar to that used during the War of 1914–18, namely, a Commission of Awards to Inventors, would be adopted.

Science and War

PROTECTION of civilian population from attack by deadly weapons that science has created is set forth as one of the paramount duties of science in the present emergency, in the annual report by Dr. Vannevar Bush, president of the Carnegie Institution of Washington, recently issued. The same science which saves life and renders it rich and full, also destroys it and renders it horrible. Is it then possible to remain in a detached atmosphere to cultivate the slowly growing body of pure scientific knowledge, and to labour apart from the intense struggle in which the direct application of science now implies so much for good or ill? As science has produced a weapon, so also can it produce in time a defence against it. Science is dedicated to the advance of knowledge for the benefit of man. Here is a sphere where the benefit might perhaps indeed be immediate, real and satisfying. Can a scientific worker, skilled in a field such that his efforts might readily be directed to the attainment of applications which would afford protection to his fellow-men against such an overwhelming peril, now justify expending his effort for any other and more remote cause?

Although immediate participation of the men of science in the safeguarding of civilization is urged by Dr. Bush, he gives the warning that we should not become stampeded. "There is still a duty to keep the torch of pure science lit, and this duty is only the greater under stress. All the long struggle of a harsh evolution, the pitting of species against the environment, has produced a being whose primary distinction is conscious cerebration, and whose crowning attribute is his intellectual curiosity concerning his complex environment and a thirst for knowledge transcending the mere struggle for existence. If there is no abiding value in a Beethoven symphony, or a theory of the cosmos, or the tracing of an ancient culture, then the Carnegie Institution of Washington has scant reason for existence. If it is really good that man should look at the stars and should contemplate his great destiny, then it is imperative that in those regions which enjoy the blessings of peace the search for the eternal verities should continue."

Recent Earthquakes

AFTERSHOCKS of the earthquake of December 26 in Turkey continue to be felt in widely separated areas. The epicentres are by no means confined to the Erzinjan-Erbaa area, thus lending support to the original estimate from Istanbul of a depth of focus of the original earthquake of the order of sixteen miles. On January 17 eight rather violent tremors were felt in the original area and other violent tremors were experienced at Istanbul, Smyrna, Castamouni, and Izmid. A *Times* report states that at the last-named place an entire hill slid downwards, blocking the road to Kandira. No further casualties are reported from these areas. On January 16 an earthquake occurred at the village of Balcikoy near Nigde, causing two hundred houses to collapse, killing five people and injuring sixteen. The death roll was small because a light foreshock preceded the principal shock, causing people to run out of doors. On January 17 at night, two more violent earthquakes were felt at Nigde, which is in southern Anatolia. These caused four hundred houses to collapse, killing fifty people and injuring a hundred and sixty others. A. Hée of the central seismological bureau, now at Clermont-Ferrand (France), has taken the readings of fifteen observatories and determined the epicentre of the original shock to have been near latitude 39·5° N., longitude 38·2° E.; initial time 26d. 23h. 57m. 23s. G.M.T.

An earthquake of intensity VII, and approaching intensity VIII on the modified Mercalli scale of 1931, was felt in Palermo at 2.18 p.m. (local time) on January 15. Much damage is reported to have been

caused to the façade of the monumental church of St. Anna, one of the oldest in Sicily; some damage has been done to the Cathedral, and cracks have appeared in many walls of the poorer type of building. Two people have been killed by falling masonry and twenty-five injured. The electricity supply was temporarily out of action. The earthquake was the most severe for many years, and alarm was caused especially amongst children and people in the poorer quarters of the city. According to a *Times* message, the epicentre of the shock is estimated to have been between Palermo and the islands of Ustica and Alicudi to the north-north-west of Palermo, which would be approximately 38·5° N., 13·25° E. This is in a relatively highly active region seismically, and earthquakes occurred near to this epicentre on August 17, 1926 (38·5° N., 15° E.) and August 21, 1930 (39° N., 14·5° E.). The great Messina earthquake of December 28, 1908, which has been described by Davison, affected this area, according to Baratta, though the epicentre was, of course, somewhat to the east of the present one.

From 1.30 a.m. on January 17, and continuing for three hours at intervals, Paris experienced earth tremors so slight that they were not felt by anyone. The tremors were recorded on the seismographs at the Paris Observatory.

Native Races and Tuberculosis

SOME interesting data bearing upon recent theory of the racial incidence of disease are brought together and discussed in relation to tuberculosis in the *Lancet* of January 13. The older view ascribed the apparently selective action of the infection on native races mainly to innate biological differences, but there is now a tendency to emphasize work and living conditions—with the consequent risk of intense exposure and deficient resistance—on one hand, and the factor of bacteriological immunity on the other. Thus a recent view is quoted in which there is represented a balance between heredity and environment. The emphasis now being laid on social factors, it is suggested, opposes the defeatist attitude that native races are just 'different', and indicates lines of action within human control.

In support of this view, attention is directed to the situation at present in India and Africa. On the Rand, although the incidence among natives working in the mines has fallen considerably in recent years, the incidence among natives in the Union has probably fallen little, if at all. All cases discovered in the mines are repatriated at once and the majority are dead in two years. Thus there is a continuous stream of infectious men returning to the territories from which are derived a return stream of new recruits. There are no sanatoria and little provision of public medical service. In India, a similar situation has arisen in the interchange between urban and rural areas which the growth of industrialism and transport facilities has made possible, with the result that Bengal alone is said to have a million cases of tuberculosis and a hundred thousand deaths annually.

Analysis of the data of the incidence of tuberculosis among non-European or primitives would seem to justify the contention that the problem is now most serious where native agricultural populations are becoming industrialized. That the situation is remediable is indicated by the situation under the Russian Soviets, where rapid industrialization has been accompanied by expansion of the tuberculosis services, with the result that there has been a notable decline in tuberculosis mortality. The writer in the *Lancet* concludes with the admonition that it is the white man's responsibility that the situation in the British Empire should be squarely faced.

Mental Disease in Peru

IN a recent paper (*Amer. J. Psychiat.*, **96**, 403; 1939) Dr. Horatio M. Pollock states that the care of the mentally sick in Peru has gone through a series of progressive stages similar to that in the development of psychiatric science in the United States. A long period of neglect was succeeded by one of inadequate care in almshouses or asylums, which in turn was followed by so-called hospital care with some degree of medical attention, and finally scientific treatment in a modern hospital. The first hospital treatment for mental patients in Peru was provided in the seventeenth century in two general hospitals at Lima, one being St. Andrew's Hospital for men and the other the St. Anne's Hospital for women. Towards the middle of the nineteenth century the special section in the St. Andrew's Hospital became an independent unit with a special physician to look after the patients, and in 1859 a new building named "Hospital de la Misericordia" for mental patients was opened in the outskirts of Lima with accommodation for 160 patients. It was divided into four sections, respectively for quiet cases, those periodically disturbed, mental defectives and epileptics, and violent cases.

In 1918 an entirely new hospital for mental patients, which was named after its benefactor Victor Larco Herrera, was opened at Magdalena del Mare about four miles from Lima with accommodation for more than a thousand patients. The treatment in this hospital has been modernized, and at the present time compares favourably, according to Dr. Pollock, with that in many hospitals in the United States. A single hospital, however, is not sufficient for all the persons requiring mental treatment in Peru. At least two more are needed, and funds are not yet available for enlargement of the present building.

Higher Education in Malaya

"HIGHER EDUCATION IN MALAYA" (H.M. Stationery Office, 2*s*. 6*d*.) is a thorough and most valuable survey. It includes the whole background of teaching and adds an able summary of the resources of the country, mainly due to the rubber plant, and the variety of its population, Chinese, Indians and Malays. The last-named have only been under Western civilization for 60–70 years. They do not dwell in towns like the Chinese. Raffles College, opened in 1928, is the main centre of advanced education, and is

increasingly appreciated by parents, who recognize the value of its teaching. One of the difficulties is that English is learnt as a foreign language; so that subject can scarcely be taken, as at the University of London, with Middle English and Anglo-Saxon as necessary adjuncts. It would be like studying Latin in early and medieval sources as well as Virgil and Cicero. The Commissioners urge that the standard of the London degree should be attempted and some modification of the English course allowed, tending to special knowledge of English masterpieces.

The present diploma of the College is not recognized outside Malaya, and not much progress can be achieved without some external assistance in the examinations, which could be managed by the use of air-mail. The professors take leave once in three years, which puts rather a heavy burden on their substitutes, but gives them a chance to meet external examiners. The present arrangements for a president are inadequate, and the "high wastage rate" of failures needs to be reduced. Several drastic improvements are suggested. We regret to notice that science teaching in the schools is generally in a very backward state, and biology has been scarcely begun. The King Edward VII College of Medicine at Singapore is well equipped and does good work within its limits; but it needs a larger scope, particularly regarding public health.

International Journal of Agrarian Affairs

THE first International Conference of Agricultural Economists was held ten years ago. As the period elapsing between meetings is now three years, some means of maintaining an interchange of ideas, beyond the issue of the proceedings, seemed desirable. The *International Journal of Agrarian Affairs*, the first number of which has just been published, is a bold attempt to meet this need. Two numbers will be brought out each year, the intention being to develop a series of studies on economic and social problems, one such problem being dealt with at a time. The *Journal* will therefore serve as a complement rather than an addition to the statistical year-books of agricultural information which are already available. The kind of topics which will form the subject-matter are those common to all countries, and the aim will be to emphasize the universal concern with the solution of such problems, and to discuss them from all possible angles.

The first number deals with the problem of surplus agricultural population. Contributions are made from such widely different localities as Harvard University, Edinburgh, Washington, Quebec, Sofia and Riga. The theoretical basis of the problem is first discussed and an account given of the historical influence of landowning. Other writers stress the effect of policies of restriction on trade and on movements of population between countries, and describe the special problems of Bulgaria and Latvia, while as regards remedies the development of subsistence holdings is advocated. Though not actually the official organ of the International Conference of Agricultural Economists, the *Journal* will be issued free to all members. For non-members the price is 3*s.* 6*d.*, or £1 per volume of six numbers (including postage). All subscriptions and communications should be addressed to the Editor, 3 Magpie Lane, Oxford.

Meteorology in Iraq

THE third annual report of the Director of the Meteorological Service of the Government of Iraq, which covers the year ending March 31, 1939, shows that, owing to the difficulty of obtaining the necessary staff, the basic organization of the Service had not been completed by that date. For example, although new offices were available at Nasiriya and Diwaniya, no staff was available to man them. At the headquarters station at Baghdad, continuous records of wind, temperature, humidity and rainfall were maintained and were analysed and published in the Monthly Weather Report. Upper winds were measured three times a day, and the results appeared in the I.C.A.N. summaries published by the Meteorological Office, London, up to December 1938. After that month they were published in Iraq together with similar summaries obtained from stations maintained by the Air Ministry, Meteorological Service, Habbaniya.

Meteorological information continued to be supplied to civil aviation from Baghdad and Basra, the number of messages rising to 1,200 per month during the winter. As the volume of air traffic over Iraq continued to increase, difficulty was experienced in maintaining this part of the service, and the need for an extension of the existing wireless service was felt. As was only to be expected, the report contains little of purely scientific interest. Owing to the fact that air-conditioning engineers were constantly asking for data concerning the dust content of the air, the Director placed an order for an Owens settlement dust counter and for the necessary microscope for measuring the records.

Lantern Slides

THE cost of making lantern slides from illustrations may be materially reduced by using paper negatives, and Mr. G. H. Bell, of the Physiological Institute, Glasgow, gives an account in the December issue of the *Journal of Scientific Instruments* of a method he has found very satisfactory. He uses "Kodaline Paper Slow" exposed for three minutes at *f*/11, the illustration being illuminated by four 100-watt lamps placed just behind the camera lens. He develops with Kodaline developer and gets a pure black and white negative. He prints on gas-light lantern plates using a mask and giving an exposure of 8 seconds for a surface intensity of 65 foot-candles, uses an energetic developer and gets a slide with black lines on a perfectly clear background both for line diagrams and half-tone illustrations.

Drift of the *Sedov*

THE Northern Sea Route Administration of the U.S.S.R. is preparing for press a collection of articles and other material relating to the remarkable drift of

the icebreaker *Sedov* in the Arctic, the crew of which was reported to have been taken off the icebound vessel by the icebreaker *Joseph Stalin* on January 13. The *Sedov* commenced her drift on October 23, 1937. The book being prepared for press tells the story of the *Sedov's* unprecedented drift. It contains articles by I. D. Papanin, head of the Northern Sea Route Administration and leader of the North Polar Expedition on the drifting icefloe of 1937–38, and by Prof. N. N. Zubov, and diaries of members of the *Sedov's* crew.

Clough Memorial Research Fund

THE Clough Memorial Research Fund of the Edinburgh Geological Society was instituted in 1935 for the purpose of encouraging geological research in Scotland and the north of England; the north of England is defined as comprising the counties of Northumberland, Cumberland, Durham, Westmorland and Yorkshire. Under the terms of administration of the Fund, a sum of approximately £30 is available annually. Applications for grants are invited for the period April 1, 1939, to March 31, 1940. These applications should state the nature of the research to be undertaken and the amount of grant desired. Applications must be in the hands of the Secretary, Clough Research Fund Committee, Edinburgh Geological Society, Synod Hall, Castle Terrace, Edinburgh, not later than March 1.

Royal College of Physicians: Lectures

THE following lectures have been arranged by the Royal College of Physicians to be delivered at the College, Pall Mall East, London, at 2.30 p.m.: Mitchell Lecture (postponed from 1939), Dr. F. G. Chandler, "Some Observations on the Diagnosis and Treatment of Pulmonary Tuberculosis" (February 7); Milroy Lectures, Dr. R. E. Smith, "Acute Infectious Diseases at School" (February 13 and 15); Goulstonian Lectures, Dr. W. D. W. Brooks, "The Pathology and Treatment of Pulmonary Tuberculosis" (February 22, 27 and 29); Bradshaw Lecture (postponed from 1939), Dr. J. C. Spence, "On the Nature of Disease in Infancy" (March 7); Oliver-Sharpey Lectures, Prof. E. P. Cathcart, "The Mystery of Alimentation" (March 12 and 14); Croonian Lectures, Dr. George Graham, "Recent Advances in Diabetes Mellitus: Aetiology and Treatment" (May 16 and 21).

Royal Aeronautical Society: Lectures

ARRANGEMENTS are being made by the Royal Aeronautical Society to resume part of the lecture programme which was postponed on the outbreak of war. It is hoped to arrange definitely for four or five lectures. The first one, on aircraft production, will be given by Mr. H. J. Pollard, on March 12 at 6.0 p.m., in the Institution of Electrical Engineers. Sir Alan Cobham and Mr. Marcus Langley have provisionally agreed to give a joint lecture on flight refuelling in the air; Mr. A. A. Hall on recent theoretical and experimental work on turbulence; Wing Commander T. R. Cave-Brown-Cave on noise and nuisance in aircraft, at dates to be fixed. The Wilbur Wright Lecture will be delivered at the end of May.

The Night Sky in February

DURING this month, the night shortens in the latitude of London by 1¼ hours. The moon is new on February 8 and full on February 23. Lunar conjunctions with the planets occur as follows: with Venus on February 11d. 21h., with Jupiter on 12d. 14h., with Saturn on 14d. 3h., with Mars on 14d. 4h. It will be seen from these conjunctions that the bright planets are a striking feature in the evening skies, enhanced by the presence of the crescent moon. On February 13 at 8h., Mars, which had overtaken Jupiter on January 7, is in conjunction with Saturn, while on February 20 at 22h., Venus and Jupiter are in conjunction. On February 28, Mercury is at greatest elongation (18° east) and should be visible low in the west after sunset, leading the train of five bright planets, in addition to Uranus (stellar magnitude 6) in the constellation Aries. The planet Neptune, which transits about 2h. in mid-February, approaches the 8th magnitude star, B.D. + 3° 2549 (Lalande 22237) on February 14. The light variation of Algol (total variation mag. 2·2–mag. 3·5) is best seen about 1¼ hours before and after the following epochs: February 8d. 4·5h., 11d. 1·3h., 13d. 22·1h. and 16d. 19·0h.

Announcements

PROF. MAX BORST, professor of morbid anatomy at Munich, has been awarded the Goethe Medal for art and science on the occasion of his seventieth birthday for his work on cancer.

SIR HUMPHRY ROLLESTON, chairman of the executive committee of the Imperial Cancer Research Fund since 1924, and Sir Thomas Dunhill, sergeant-surgeon to the King, were admitted to the honorary fellowship of the Royal College of Surgeons of England at a meeting of the Council on January 11. Sir Hugh Devine, president of the Royal Australasian College of Surgeons, has accepted the honorary fellowship subject to the condition of personal attendance at the College at some future date.

THE number of births in France, which was 1,022,000 in 1876, fell to 750,000 in 1930 and 616,000 in 1939. For the last three years the number of deaths has exceeded the number of births by 14,000 annually.

DR. FRANS VERDOORN, formerly of Leyden, Holland, has now gone to the United States. Dr. Verdoorn controls the following publications: *Chronica Botanica*, New Series of Plant Science Books, "World List of Plant Science Institutions", "International Address Book of Plant Taxonomists", *Annales Bryologici* and other bryological publications. All communications concerning these should now be addressed to Dr. Frans Verdoorn, Chronica Botanica Co., c/o the Arnold Arboretum, Jamaica Plain, Mass., U.S.A.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

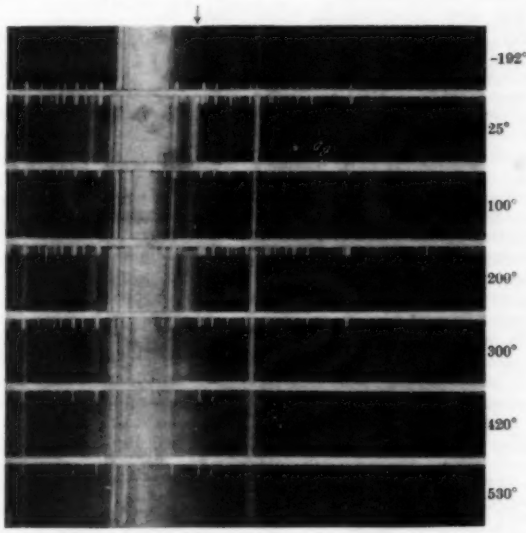
NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 151. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The α-β Transformation of Quartz

As is well known, the ordinary form of quartz which has trigonal symmetry changes over reversibly to another form which has hexagonal symmetry at a temperature of 575° C. Though the transformation does not involve any radical reorganization of the internal architecture[1] of the crystal and takes place at a sharply defined temperature, it is nevertheless preceded over a considerable range of temperature (200°–575°) by a progressive change in the physical properties of 'low' quartz which prepares the way for a further sudden change, when the transition to 'high' quartz actually takes place. The thermal expansion coefficients, for example, gradually increase over this range of temperature, becoming practically infinite at the transition point and then suddenly dropping to small negative values[2]. Young's moduli in the same temperature range fall to rather low values at the transition point and then rise sharply to high figures[3]. The piezo-electric activity also undergoes notable changes[4,5].

In the hope of obtaining an insight into these remarkable phenomena, a careful study has been made of the spectrum of monochromatic light scattered in a quartz crystal at a series of temperatures ranging from that of liquid air to nearly the transition point. Significant changes are observed which are illustrated in the accompanying illustration, reproducing part of the spectrum excited by the 4358 A. radiation of the mercury arc. A fully exposed spectrum at room temperature indicates fourteen different normal modes of vibration of the crystal. At liquid air temperature, the three most intense lines correspond to the frequency shifts 132, 220 and 468 cm.$^{-1}$ and are all about equally sharp. As the crystal is heated over the temperature range 200°–530°, notable changes occur. The 220 cm.$^{-1}$ line (marked with an arrow in the reproduction) behaves in an exceptional way, spreading out greatly towards the exciting line and becoming a weak diffuse band as the transition temperature is approached. On the other hand, the other intense lines having both larger and smaller frequency shifts continue to be easily visible, though appreciably broadened and displaced.

The behaviour of the 220 cm.$^{-1}$ line clearly indicates that the binding forces which determine the frequency of the corresponding mode of vibration of the crystal lattices diminish rapidly with rising temperature. It appears therefore reasonable to infer that the increasing excitation of this particular mode of vibration with rising temperature and the deformations of the atomic arrangement resulting therefrom are in a special measure responsible for the remarkable changes in the properties of the crystal already mentioned, as well as for inducing the transformation from the α to the β form.



LIGHT SCATTERING IN QUARTZ.

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T. M. K. NEDUNGADI.

Department of Physics,
Indian Institute of Science,
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Dec. 11.

[1] Bragg and Gibbs, *Proc. Roy. Soc.*, A, **109**, 405 (1925).
[2] Jay, *Proc. Roy. Soc.*, A, **142**, 237 (1933).
[3] Perrier and Mandrot, *C.R.*, **175**, 622 (1922).
[4] Osterberg and Cookson, *J. Frank. Inst.*, **220**, 361 (1935).
[5] Pitt and Mckinley, *Canad. J. Res.*, A, **14**, 58 (1936).

First Benedicks Effect in Gas-free Mercury, as Influenced by the Mean Temperature

IN a previous letter[1] we have shown that, in mercury carefully freed from gas ions, the First Benedicks effect exists with a positive sign, whereas in the presence of gas ions the effect had shown a negative sign. The influence of gas ions actually seems thoroughly to modify the thermo-electric properties of some metals.

In view of the fundamental character of this influence, the experiments on mercury have now been repeated, using a strangulation apparatus made of silica, with a new heating arrangement (hot and cold flowing oil), and also a photographic registration method. Fig. 1 exemplifies the registrations finally obtained: in the upper parts are to be seen the relay-amplified deflections of the galvanometer, showing small oscillations due to Brownian movement; below, the corresponding temperature registrations.

The new observations were found entirely to confirm the positive character of the effect in gas-free mercury. They further reveal a new, important fact.

From a quantitative point of view, the effect is determined by the formula

$$u = K \cdot \frac{3}{\triangle t} \qquad (1)$$

The parameter K, depending on the metal and, to a certain extent, on the apparatus used (here No. 20), and hence now designated as K_{20}, has been calculated from the observations, using (1), and plotted as ordinates in Fig. 2, where abscissæ are the mean temperatures t_{med}.

It will be seen that the effect varies with the temperature, *increasing in a strongly accelerated way*.

It is interesting that this increase, with increasing temperature, of the First Benedicks effect appears to be just the same as that which has been discovered earlier for the reversed effect, the Second Benedicks

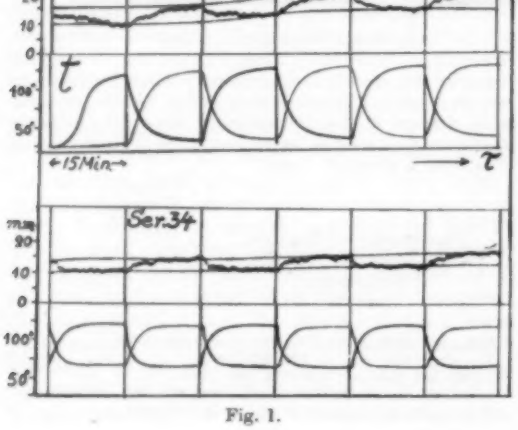

Fig. 1.

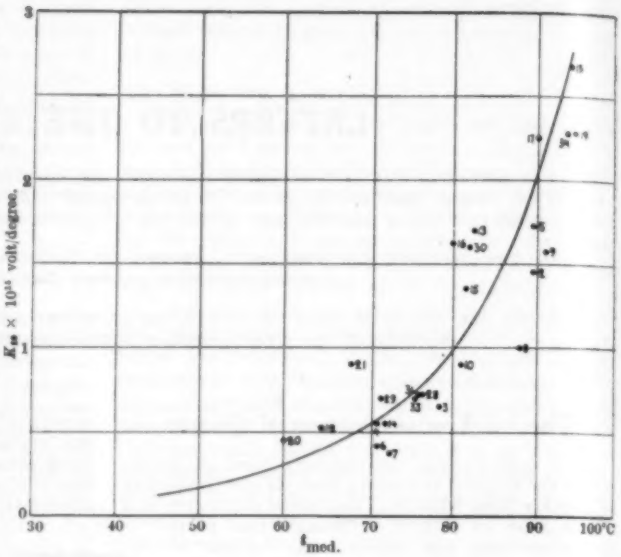

Fig. 2.

FIRST BENEDICKS EFFECT IN MERCURY.

effect[2], and which presents a striking similarity to the well-known Richardson formula, valid for electron emission from glowing metals. It actually appears plausible that the emission of electrons along a steep temperature gradient in the metal may follow the same law as the emission into vacuum.

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[1] NATURE, **141**, 1097 (1938).
[2] Benedicks, C., and Siljeholm, G., *Ark. Mat. Astron. Fys., Stockholm*, **24 A**, No. 7 (1933), (see Fig. 41).

Magnetic Anisotropy of Diphenyldiacetylene

E. H. WIEBENGA has recently determined the crystal structure of diphenyldiacetylene[1], $(C_6H_5).C{\equiv}C.C{\equiv}C.(C_6H_5)$. The molecule is plane, with a straight carbon chain, the length of the molecule making angles of approximately 48°, 52°, 78° with the *a*,*b*,*c* axes of the monoclinic unit cell. (By inadvertence, the complements of the first two angles were given in Dr. Wiebenga's letter in NATURE. He has since very kindly sent me the exact direction cosines determined by means of a Fourier analysis, and has also provided me with some beautiful crystals for this investigation.)

The magnetic anisotropy of the crystals, weighing about 4 mgm. each, density 1·170 gm./c.c. at 20° C., was determined by Krishnan's second method in a field of some 7,000 oersted. The minimum diamagnetic susceptibility was determined by the flotation method. The principal crystal susceptibilities are $\chi_1 = -93{\cdot}8 \times 10^{-6}$ ($\pm 0{\cdot}5$), $\chi_2 = -188{\cdot}0 \times 10^{-6}$, $\chi_3 = -109{\cdot}6 \times 10^{-6}$, $\psi = -88{\cdot}5°$. Hence the mean

susceptibility is $-130{\cdot}5 \times 10^{-6}$, as compared with $-115{\cdot}9$ for tolane and $-102{\cdot}9$ for diphenyl. Pascal's rules would give $\bar{\chi} = -129{\cdot}7$ for diphenyldiacetylene: he himself found the value $-129{\cdot}3$ (corr.). The principal susceptibilities of a single molecule, deduced from the above data and the molecular direction cosines, are $K_L = -109{\cdot}4$, $K_M = -75{\cdot}3$, $K_N = -206{\cdot}7 \times 10^{-6}$.

Comparing these with the corresponding values for tolane[2], $K_L = -81{\cdot}5$, $K_M = -67{\cdot}8$, $K_N = -198{\cdot}5 \times 10^{-6}$, it will be seen that there is an abnormal increase of susceptibility along the carbon chain axis, indicating a concentration of electron density normal to that axis. This is in sharp contrast to the behaviour of chains of conjugated double bonds, for which the increase of susceptibility is always normal to the plane of the molecule, indicating a concentration of electron density in that plane. An exact Fourier analysis of the structure of diphenyl is very desirable, in order to extend the comparison from tolane to diphenyl.

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Jan. 9.

[1] Wiebenga, E. H., NATURE, **143**, 980 (1939).
[2] Lonsdale, K., *Proc. Roy. Soc.*, A, **171**, 564 (1939).

Crystal Structure of Phosphorus Pentachloride

ALTHOUGH much work has been done on the molecular structure of phosphorus pentachloride, no crystal structure determination of this important substance has previously been made, presumably owing to experimental difficulties. In our separate laboratories, independent X-ray diffraction experiments have given the following results: Crystal system tetragonal, approximate cell dimensions $a_0 = 9{\cdot}2$, $c_0 = 7{\cdot}4$ A., density *circa* 2·0 gm./c.c., 4 molecules per unit cell, space group $P4/n$.

This information is sufficient to determine the constitution of the compound. Consideration of the space group symmetry and the available space shows that it is impossible to form a structure containing PCl_5 molecules of any configuration. For similar reasons the constitution $[PCl_4]^+Cl^-$ may also be rejected. An ionic structure containing tetrahedral $[PCl_4]^+$ and octahedral $[PCl_6]^-$ groups completely satisfies the requirements. For a unit cell with origin as in the "Internationale Tabellen zur Bestimmung von Kristallstrukturen", the centres of $[PCl_4]$ groups are at 000, $\frac{1}{2}\frac{1}{2}0$, and those of $[PCl_6]$ at $0\frac{1}{2}z$, $\frac{1}{2}0z$, $z \approx \frac{1}{4}$. Preliminary Fourier analyses have confirmed these conclusions, and further details of the structure will be given later.

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D. CLARK.

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University Museum,
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A. F. WELLS.

Crystallographic Laboratory,
Cambridge.
Dec. 23.

Degeneracy and Dissociation Constants

THE importance of degeneracy in enhancing the stability of radicals such as triphenylmethyl has been emphasized by many authors; for example, Pauling and Wheland[1], Ingold[2], etc. This being so, it is strange that no relations have been suggested between complexity of degeneracy (which we may define in terms of the number of possible resonating structures) and dissociation constants of series of related acids and bases. It is probable that simple relations will be discovered only in series where the inductive effects of substituent groups are negligible, or can be eliminated.

Consider the series of acids, methyl alcohol (K of the order 10^{-16}), acetic acid ($K = 1{\cdot}75 \times 10^{-5}$), phenylacetic acid ($K = 4{\cdot}88 \times 10^{-5}$), and diphenylacetic acid ($K = 11{\cdot}5 \times 10^{-5}$). (All K values, which are thermodynamic ones, have been taken from Dippy's recent article[3].) Now the inductive effect of the C=O group moment fails to account for the enormous increase in strength (the ratio being 10^9) when we proceed from methyl alcohol to acetic acid, for chloracetic acid is only 100 times as strong as acetic acid. However, two resonating structures ($n = 2$) are possible for the acetic acid molecule ion, and the energy of resonance effects stabilization.

In the same way, the inductive effect of the phenyl group, which must be very small, will not account quantitatively for the acid strengths of phenylacetic and diphenylacetic acids. Even if we assumed (wrongly) that the increase in K in going from acetic to phenylacetic acid is due to an electrical inductive effect of the phenyl group generally designated as $-I$, the strength of diphenylacetic acid is definitely larger than what we should deduce on that hypothesis. It seems fairly obvious that the enhanced stability of the phenylacetic and diphenylacetic acid ions is due to an increase in the number of resonance

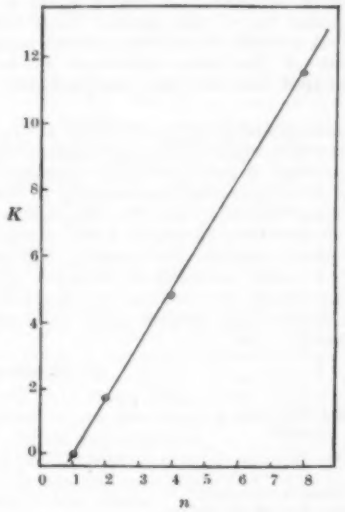

Fig. 1

possibilities, for it is easy to show that $n = 4$ and $n = 8$ respectively, and a linear relation (see Fig. 1) exists between K and n for the three acids. A fourth point for the line is provided if we assume that a non-resonating 'acetic acid' ($n = 1$) would have a strength of about 10^{-13} or zero on our scale. (Dippy and Lewis[4] have already identified the apparent intrinsic attraction for electrons exhibited by the phenyl group with its unsaturated character.) The dissociation constant of triphenylacetic acid in water has not been measured on account of solubility difficulties. Its strength may be predicted by extrapolation to $n = 16$ as $K = 25 \times 10^{-6}$.

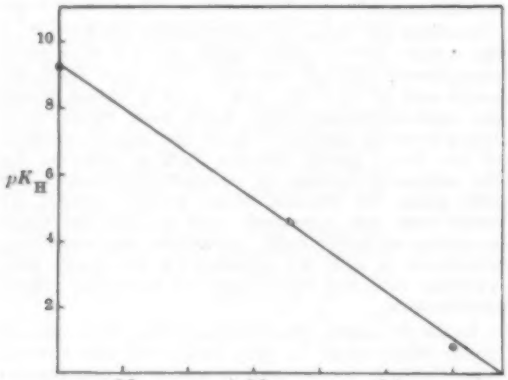

Fig. 2

In the case of a series of related bases, ammonia ($pK_H = 9{\cdot}27$, $n = 1$), aniline ($pK_H = 4{\cdot}62$, $n = 5$), diphenylamine ($pK_H = 0{\cdot}85$, $n = 16$), and triphenylamine ($pK_H = 0$, $n \gg 30$), it is the unionized molecule which is preferentially stabilized by the resonance energy. (Unlike the ion, the unionized molecule has a lone pair of electrons.) In Fig. 2 a plot is shown of pK_H against log n, and again a linear relation is found. This method of plotting is more convenient on account of the large difference in basicities. Triphenylamine has zero pK_H as predicted by the relation.

These methods of plotting are really equivalent to plotting the dissociation constant against the total resonance energy involved as n is increased. Each additional structure contributes equally to the actual hybrid state of the molecule. An examination of the dissociation constants of related series of compounds (and activation energies when reacting) will probably yield just as much valuable information about the relative importance of structures as heat data, internuclear distances, and electric dipole moments have already done.

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Dec. 6.

[1] *J. Chem. Physics*, **1**, 362 (1933).
[2] *Trans. Farad. Soc.*, **30**, 52 (1934).
[3] *Chem. Reviews*, **25**, 151 (1939).
[4] *J. Chem. Soc.*, 1008 (1937).

Predaceous Phycomycetes from Cotswold Leaf-Mould

DREHSLER[1] has described in America more than a dozen species of Phycomycetes parasitic on nematodes and terricolous amœbæ. These he places in the Zoopagaceæ, a family of uncertain taxonomy, related to the Mucorales. To the best of my belief, no members of this family have been recorded in Europe, with the possible exception of some organisms described by Penard[2] in 1913, and placed by him, probably incorrectly, in the Saprolegniaceæ. It may be of interest, therefore, to record the finding of four species of Zoopagaceæ in plate cultures inoculated with leaf-mould from wooded areas in the Cotswolds.

Cochlonema verrucosum, Drechsl., is endoparasitic in soil amœbæ. Infection begins by a conidium becoming attached to the pellicle of an amœba, and sending out a germ tube which enters the host and forms a mycelium within the endoplasm. This mycelium is thalloid, at first sub-spherical, becoming sausage-shaped, and finally twisted in a close spiral, usually of about one and a half turns. The diameter of a mature hypa is about 6 μ. Growth takes place at the expense of the host's protoplasm; but the host remains active until the parasite reaches an advanced stage. Multiple infection is usual. Finally, the host becomes immobilized and dies. Reproduction then occurs by means of chains of aerial conidia, borne on conidiophores usually 1·5 μ in diameter. The conidia are fusiform, 7 μ long and 1·5 μ in greatest diameter.

Sexual reproduction takes place by the union outside the host of slightly unequal gametangia. Zygospores are usually formed between gametangia from different mycelia; they are 10 μ in diameter and are enclosed in a thick wall, bearing on its outer surface twenty or more bullate protuberances.

Cochlonema dolichosporium, Drechsl., resembles *C. verrucosum* in size and habit, and was found attacking *Amœba similis*, Greef. It is characterized by its chains of elongate conidia, which have an average length of 20 μ and greatest diameter 1·5 μ. Like the conidia of *C. verrucosum*, their external wall is considerably sculptured. Zygospores of this species were not observed.

Stylopage haplæ, Drechsl., forms a sparsely branching mycelium, the branching being roughly at right angles. The hyphæ are non-septate, 1·2 μ–1·5 μ in diameter, and the cytoplasm is considerably vacuolated. Amœbæ become attached to the hyphæ, which send out dichotomously branching haustoria into the endoplasm of the host; the host eventually becomes completely absorbed, leaving only the shrivelled pellicle attached to the haustorium. Reproduction is by clavate conidia, 15 μ long and 2 μ–2·2 μ wide at the broadest part, borne singly on erect conidiophores 20 μ–30 μ long. Zygospores were not observed.

Stylopage hadra, Drechsl., resembles *S. haplæ* in habit, but is much larger, the rather straight, non-septate hyphæ measuring 4 μ–5 μ in diameter. This species catches nematodes, which become attached to the hyphæ, probably by means of some sticky substance. A bulbous lateral protuberance is formed on the hypha at the point of attachment of the nematode, and, from this, hyphæ grow out and ramify inside the host, absorbing its contents. Ultimately, only the withered integument of the nematode is left, attached to the bulb. Reproduction is by ovoid conidia, 25 μ–35 μ long and 15 μ–20 μ in greatest

diameter, formed terminally on aerial conidiophores which may, by repeated growth, bear several conidia. Zygospores were not observed.

Further details of these and other related fungi will be the subject of a paper to be published later.

I should like to express my thanks to Dr. B. Barnes for much valuable advice and help, and also to Dr. C. G. C. Chesters, of the University of Birmingham, for kindly allowing me to use his laboratory.

C. L. DUDDINGTON.

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Chelsea Polytechnic,
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Jan. 4.

[1] Drechsler, C., *Mycologia* **27**, 6–40; 176–203; 206–215 (1935).
[2] Penard, E., *Arch. Protistenk.*, **26**, 78–140 (1912–13).

Radium Treatment

REFERENCE is made in NATURE of December 9, 1939, p. 973, to a paper (*J. Roy. Soc. Arts*, Dec. 8, 1939) entitled "The Penetration of Rays through the Skin, and Radiant Energy for the Treatment of Wounds", in which I express the view that we would be little the worse off if all the radium now buried in deep holes for security from bombing remained there, and states that the Cancer Act is Great Britain's reply to the question whether monetary influence determines the practice of radium therapy in Great Britain.

Radium, a destroyer of living cells in active division, cannot be used to attack cancer without also damaging living normal cells of the circulating blood, etc. It can only be used for accessible cancers in the skin or surfaces of the body, which can be removed in nearly all cases by the knife or the diathermy needle of the surgeon; and these last do not cause necrosis and incurable neuralgias, which have often followed the use of radium. Deaths due to leucopænia have resulted from vain attempts to cure deep cancers by the use of radium in bombs. I can instance the damage done by radium by a case now attending the St. John Clinic and Institute of Physical Medicine; radium treatment of a small epithelioma in the skin on the side of the skull resulted in necrosis of the bone, probably incurable, in an area the size of the top of a sherry glass.

Loss of well-being and an incurable neuralgia were recorded by Mr. Furnival, the late distinguished surgeon, who died not long after radium treatment, in his case of cancer of the throat. Such an intolerable neuralgia was suffered by a relative of mine through treatment of a cancer of the root of the tongue, and he also died of a recurrence; and I have heard of many other such cases. There are good clinicians who hold the view that the use of radium favours the spread of metastases. Radium is popular because it can be used instead of the knife, which people dread, and therefore doctors use it.

X-ray apparatus is now available which operates at a million volts or more, so that radiations approaching those of radium are produced. The dosage of radium is controlled by time and filtration; that of X-rays can be further controlled in wave-length and intensity. Radium may be chosen as more convenient for application in such a place as the larynx.

Both radium and X-rays can produce, not only necrosis, but also cancer, and Sir Norman Walker considers that the use of X-rays for lupus should be abandoned. I know of an excellent laboratory servant who, only by continued observation and treatment, is kept, so far, free from cancer resulting from scars due to X-ray treatment of lupus of the face.

We know that death has resulted in several workers who licked the paint off brushes when applying luminous, radioactive paint to watch dials, and cancer has resulted from a radium tube being left in the body. Those who mine radium-bearing ore die generally from cancer of the lung.

The *Lancet* (Dec. 23, 1939) says, "to ensure that radiation treatment is in charge of really competent workers, and to give opportunities for training therapists, a high degree of centralisation will be more effective than the creation of individual treatments units". "To use both radium and X-rays to the best advantage some surgical training and a good grasp of radiation physics are needed, and for the purpose of the Act clinical knowledge of cancer in all its manifestations as well".

While vast sums have been spent on radium, numbers of poor people have to die, unrelieved, of cancer, in their homes. The pressing needs are to spread knowledge, secure prevention where possible, and very early diagnosis, allowing a hopeful removal by the knife or diathermy needle, which can be used by surgeons everywhere, the use of radium or X-rays being reserved for one or two places in the body where surgical operation is very difficult, and to be used by specialists as the *Lancet* suggests. There is no trustworthy evidence that radium in weak doses has any beneficial action.

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Jan. 5.

"Evidence for Transformation of Mesotrons into Electrons"

IN our note under this title published in NATURE of January 20, p. 102, we stated in reference to the cloud photographs reproduced that the faint electron track *FG*, leaving the end of the mesotron track "is comparable in density with the tracks of other fast particles" in the photograph. This was the case in the original negatives, in the prints submitted for publication, and in the first proofs received, except that in the latter all the tracks were fainter. However, in Fig. 1 of the published note, the track *FG* appears much more pronounced and thicker than in the original prints—being quite obvious while other electron tracks in the same region are scarcely detectable. A new set of blocks was made for the final publication; the Editors assure us that no part of Fig. 1 received preferential treatment and suggest that the great intensity of the track concerned may have arisen from a very favourable inclination of its direction with the mesh of the screen used in reproduction.

We take this opportunity of pointing out that the arrow pointing to the δ-track at *E* in Fig. 4 should be about 2 mm. lower.

E. J. WILLIAMS.
G. E. ROBERTS.

"Victorian Socialism"

IN a very interesting essay entitled "Victorian Socialism" which Dean Inge contributed to NATURE of January 13 as if it were a review of my "New World Order", he makes certain statements for which I think it is reasonable to demand documentation. He says that the Nationalists (that is, the Franco rebels) took arms "against those devils in human shape, the Spanish Reds", etc. But is it not a matter of fact and common knowledge that Franco led his Moors against a Liberal Republican Government which had recently suppressed a very dangerous anarchist-socialist rising? (see Sender's "Seven Red Sundays", translated by Sir Peter Chalmers Mitchell, F.R.S.). Further, he gives an explicit account of abominable atrocities committed at Ronda. But surely in NATURE we want something more than an unnamed "American eye-witness" for statements of that sort. Who was he? How can we check his testimony? Is he available for cross-examination? Then about that three hundred thousand men and women "butchered under orders from Moscow". Is there a single respectable scrap of evidence for any part of that statement. Which we may find quoted presently as a statement made in NATURE.

H. G. WELLS.

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I HAVE made a careful study of the Spanish horrors, and have accepted none but well-documented evidence. The Ronda story is from a book by Arthur Bryant. I could have found several equally dreadful examples by Spanish eye-witnesses, but some of them I did not care to keep on my shelves. The estimate of 300,000 victims is official; some have put the number much higher. Krivitsky's "I Was Stalin's Agent" is most illuminating; for example, p. 120: "The Ogpu had done a brilliant piece of work. In Dec. 1936 the terror was sweeping Madrid, Barcelona, and Valencia. The Ogpu . . . carried out assassinations and kidnappings. . . . The Soviet Union had a grip on Loyalist Spain, as if it were already a Soviet possession." This book may be enough for my friend Mr. Wells, who is a very honest man.

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Scientific Workers and the Armed Forces

THE announcement published in NATURE of January 13, p. 61, "that the operation of the Schedule of Reserved Occupations is being relaxed to enable men at or above the age of reservation in scientific occupations to volunteer in approved cases for service in the Forces" calls for certain comments.

The increase in unemployment among scientists, particularly chemists and biologists, which may be the cause of this relaxation of the schedule and is the cause of much concern in this Association, is largely due to the reduction of 'civilian' research and the impossibility of absorbing all these scientists into direct war research. Through the somewhat uneven incidence of the economy campaign, many lines of research are already in jeopardy; it is only necessary to mention the example of food research. In the leading article of the same issue of NATURE, suggestions are made for new lines of research directly related to the needs of the population in war-time. In addition to such lines of work, there can also be suggested scientific work which is of less direct importance to a country at war but should be inaugurated at once so that its results may be available when required. The most obvious example of this kind of work is research on problems of substitute materials, in which Germany is at present probably ahead of Great Britain.

The fact that chemists and other scientists are now allowed to enlist in the Forces in other than their professional capacity suggests that there is a shortsightedness in the scientific direction of the country.

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(Hon. General Secretary.)

Association of Scientific Workers,
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Points from Foregoing Letters

THE ordinary form of quartz with trigonal symmetry changes at 575° to a form with hexagonal symmetry, the change being preceded by a progressive change of physical properties. Sir C. V. Raman and T. M. K. Nedungadi find an explanation for these effects as a result of an examination of the scattering of monochromatic light in quartz at various temperatures up to the transition point.

The First Benedicks effect (passage of an electron current in a metal subjected to a temperature gradient) in gas-free mercury has been re-examined by C. Benedicks and P. Sederholm. They find that the effect increases rapidly with increase of the mean temperature of the metal, the law of increase being similar to that for the emission of electrons into a vacuum (Richardson's law).

The principal diamagnetic susceptibilities of the diphenyldiacetylene molecule have been measured by K. Lonsdale. A concentration of electron density normal to the carbon chain axis is indicated by a comparison of the results with those previously found for tolane.

Independent X-ray crystallographic examinations of phosphorus pentachloride by H. M. Powell and D. Clark in Oxford and by A. F. Wells in Cambridge have established the constitution of this compound in the solid state. The structure contains tetrahedral $[PCl_4]$ and octahedral $[PCl_6]$ groups.

H. O. Jenkins finds that linear relations exist between the complexity of degeneracy, defined in terms of the number of possible resonating structures, and the dissociation constants of series of related acids and bases.

C. L. Duddington describes four species of predaceous Phycomycetes, belonging to the Zoopagaceæ, found in leaf-mould from the Cotswolds.

RESEARCH ITEMS

A Neolithic Trackway

A POSSIBLE Neolithic trackway across the Cotswolds has been traced by Miss C. A. Simpson and Miss Clifford and is described by them in *Geography* of December. It extends north-eastward from Bisley by Duntisbourne, Chedworth and Northleach to the edge of the low and swampy ground of the Windrush valley west of Bourton-on-the-Water, where it swings north and then west towards Nutgrove and beyond. In Neolithic times the limestone plateau of the Cotswolds was probably covered by low scrub and there were few trees. The valleys, however, were mainly floored by clay and sand, and afforded marshes which restricted the crossing places. On the plateau the trackway is less easy to trace, for it was probably less well defined. Long barrows in conspicuous places were probably landmarks and also the objectives of some of the travellers. Flints and stone weapons are also useful clues. On the valley sides, however, the track is frequently sunk either in clay or limestone outcrops. Projecting spurs of firmer ground often lead to the river crossing. In some places the route follows a line of present road, but more often it is marked, if marked at all, by a narrow lane, a bridle path or even a double line of hedge. The authors' discussion of the evidence to be sought in tracing the trackway has many useful indications for such work.

Feet of Melanesians and Europeans

A STUDY of the footprints of sixty-five natives of the Solomon Islands by Clifford S. James, of the Melanesian Mission Hospital, Malaita (*Lancet*, **237**; Dec. 30, 1939), affords material for contrast with those of Europeans. The longitudinal arch exists in both Melanesians and Europeans and is a definite fixed part of the anatomy. This is contrary to the view recently expressed that there is no fixed arch "in primitive races who have never worn boots or shoes". As regards differences between the foot of a European and the Solomon Islander, that of the latter is more massive and broader, especially in the male, lacking the 'elegance' (usually pathological) of the European foot. The toes of a native are straight, lie parallel with the ground, and are spread out so that the inner and outer borders of the foot are two straight lines. Occasionally the great toe is abducted so that the inner border of the foot is concave medially, and the other foot has to 'step over' the great toe. A native in walking uses his toes more than does a European; and the final push-off is from the toes. The most obvious difference in the two footprints is that the European's foot is always turned outwards to various degrees when walking, while that of the native has its inner border pointing straight ahead with slight variations one way or another. The female foot being less massive than the male, its mobility and pliability are most noticeable, especially as shown in the way the foot spreads out over the ground when the body weight is put on to it. The print of a European aged 5½ years who had never worn shoes, when superimposed on that of a native, showed striking similarities. Flat-foot does not occur among the natives.

Biological Control of a Fungus Disease

THE honey fungus, *Armillaria mellea*, is of world-wide distribution. It is widespread upon forest trees in Great Britain, and is very destructive to tea plantations in Nyasaland. R. Leach has made some interesting experiments on biological control of the disease in the last-mentioned venue (*Trans. Brit. Mycol. Soc.*, **23**, Pt. 4; December 1939). Forest land has to be cleared of trees before tea bushes can be planted. The fungus attacks roots left in the soil, and later can transfer its parasitism to the economically valuable bushes, with disastrous results. Cutting a ring of bark from trees some time before they are felled, however, depletes the roots of carbohydrates, and thereby deprives *A. mellea* of an acceptable substrate. It does, in fact, effect such a large edaphic change that other organisms establish themselves in the decaying roots, and exclude the parasite, which can even be prevented from spreading by felling a belt of bark-ringed trees.

New Descriptions of Agarics

THE Aviemore foray of the British Mycological Society yielded some interesting new records of Agaricaceous fungi, mostly of the genus Russula, which are described by A. A. Pearson in the Society's *Transactions* (**23**, Pt. 4; December 1939). Several of the species, as *R. rosea*, *R. vinosa and R. gracillima*, have occurred in other countries, but a new species, *R. scotica*, is also delineated. This is similar to *R. cremeo-avellanea*, which is found in the Pyrenees; but differs in the non-reticulated spore and absence of cystidia on the pileus.

Shoot Wilt of *Prunus triloba*

THE fungus *Botrytis cinerea* is often thought of as a saprophyte, but it has been found to show active parasitism upon some plants. W. C. Moore has recently described a shoot wilt disease of *Prunus triloba*, caused by this organism (*Trans. Brit. Mycol. Soc.*, **23**, Pt. 4; December 1939). New shoots wilted suddenly shortly after flowering, the bark died and it became brown. A wilted flower cluster was always associated with such shoots, and the disease appeared most severely when the weather was wet before the end of May. Pathogenicity of the organism mentioned was proved by isolation and re-inoculation.

Theory of Differential Periodicity

G. F. SLEGGS (*Growth*, **3**, 173–179; 1939) puts forward a theory of gene structure and development of the organism which is based on the interactions of protein lattices. If one projects all the genes, cytoplasm and other intergenic material in every cell of the organism into one structure, the author considers that the genes are equivalent to a stack of horizontal lattices differing in spatial period. Growth then is basically a process of lateral extension of the vertical strips of the lattice system. The minimum effective fragment will be a chain of the mesh, for example, the spireme. The equipotentiality of the system lies in the fact that any vertical strip can regenerate the whole differential pattern of the

lattice stack. All genes are thought to be similar, differing only in spatial arrangement. The differential in the amino-acid frequency is believed to result from gene rotation. On this view it is possible to account for differential mitosis, the relationship between cytoplasmic and other intergenic material and growth phenomena, and evolutionary trends by the conception of rotations in a protein lattice stack.

Genetics of *Primula kewensis*

MOST interesting facts have resulted from the examination of *Primula kewensis* by M. Upcott (*J. Genetics*, **39**, 79–100; 1939). There are two types of tetraploids known; the first resulted from the doubling of chromosomes in branches of the diploid cross *P. floribunda* × *P. verticillata*; the second arose from backcrossing the first type to *P. floribunda*. The first contains two complements each of *floribunda* and of *verticillata* chromosomes while the second contains three sets of *floribunda* to one of *verticillata*. The diploid, sterile *P. kewensis* forms bivalents and one to two pairs of univalents. The sterility of the hybrid is not due to difficulties of chromosome pairing. Evidence has been provided of the manner in which gametes with less than the normal reduced number of chromosomes may occur. 8 per cent of the pollen grain division of the tetraploid *P. kewensis* showed "double plates"; that is, either several chromosomes lie off the main divisional plate and form a secondary plate on their own or the mitotic spindle is curved. Should the chromosomes forming the secondary plate be a compatible complement, say $n = 9$, there is a chance of gamete production with 9 chromosomes in place of the normal 18 from tetraploid *P. kewensis*. It is shown that tetraploids have consistently a lower chiasma frequency than the related diploids.

Quantitative Characters

LEROY POWERS (*J. Genetics*, **39**, 139–170; 1939) describes an experiment in *Lycopersicum esculentum* and *L. pimpinellifolium*, in which the analysis of variance is applied to the study of the inheritance of the number of locules and the size of fruit. He shows how the analysis of variance may be usefully applied to genetical problems. Variances were heterogeneous for "between genotypes" and for "between generations" and, to some extent, for "between sampling blocks". The variability of the variances is a function of genotypes. There would appear to be at least three pairs of allelomorphs involved in the determination of both number of locules and size of fruits. Their interactions are geometrically cumulative, but it is shown that interactions between pairs of allelomorphs are different from those within pairs, and proper experimental methods should be adopted to keep these differences distinct.

Greenland Ice Sheet

THE advance and retreat of valley glaciers is frequently cyclic and not progressive in either direction. It is often more dependent on local topography than on changes in climate. In recent observations in north-west Greenland ("Contributions to the Glaciology of North-West Greenland", *Meddelelser om Grønland*, **125**, No. 3), J. W. Wright shows that advance and retreat have occurred in the Moltke Glacier this century, but agrees that other evidence than that of valley glaciers is required for movements of the ice cap. This evidence he believes he has found, pointing to a recent retreat of the ice cap in Inglefield Land. Several new nunataks have appeared during the last few years; their appearance is vouched for by Eskimos. A long narrow lake, on the ice-free land, but adjoining the ice cap, has lately undergone a drop in level as shown by the former strand line; presumably its outlet until recently was dammed by a tongue of the ice which has now disappeared. Further evidence of retreat is the occurrence along the edge of the ice cap of rock not yet bearing the normal covering of lichen. Lastly, Mr. Wright cites the disappearance during the last ten years of an ice cap covering a small island and the melting of the snow drifts that were perennial on the slopes east of Thule.

Microseisms and Transmission of Atmospheric Disturbances

As the result of the mathematical examination of an ideal case in which atmospheric disturbance is transmitted through a layer outside or within which a steady air current is blowing, Katsutada Sezawa and Kiyoshi Kanai (*Bull. Earthquake Res. Inst. Tokyo Imp. Univ.*, **17**, Pt. 3, 548–557; 1939) arrive at some interesting conclusions. When it is possible for the disturbance to be transmitted through such a layer, the amplitude of the waves becomes a maximum for a certain range of periods, which condition would be one of the important causes of microseismic oscillation. It is possible for there to be two kinds of waves transmitted along this ideal atmospheric layer; one has a velocity comparable with that of sound waves and the other has a velocity of the order of a small fraction of the velocity of sound waves. Waves of both these kinds are transmitted only in the same or the reverse direction of the wind. The condition determining such a direction of wave transmission depends on wind velocities both in the upper and lower atmospheres. It is pointed out that microbarometric records register an aggregate of local disturbances of smaller periods, particularly those of a gravitational nature, and it may not be possible to pick out the main oscillations of smaller periods that occur in a relatively large area. For this reason it may not be possible to show any correspondence between microbarometric oscillations and microseismic oscillations.

Use of Monochromatic Image in the Spectrohelioscope

M. A. ELLISON has published a paper on the formation of the monochromatic image in a spectrohelioscope (*J. Brit. Astro. Assoc.*, **50**, 2; 1940) which will prove very useful to solar observers. As it deals with various details too numerous to summarize in a short space, those who are interested in the subject are referred to the original paper. Briefly, Ellison considers the three possible arrangements for the 'scanning' and 'viewing' slits, and points out the advantages as well as the disadvantages of each one. He refers specially to the convenience when the slits are placed side by side, about five inches apart and parallel to one another, a method adopted by F. J. Sellers, director of the Solar Section of the British Astronomical Association. A description of the apparatus has already appeared (*J. Brit. Astro. Assoc.*, **48**, 6; 1938) and Ellison has used a similar apparatus with his spectrohelioscope, the results being very satisfactory. A short account is given of the Anderson prism device, which is an alternative to the slit mechanism and was applied by Hale to the spectrohelioscope.

FURTHER APPLICATIONS OF THE PHOTOGRAPHIC METHOD IN NUCLEAR PHYSICS

By Dr. C. F. Powell,

The Wills Physical Laboratory, University of Bristol

In a letter published in NATURE of July 15, 1939, p. 115, attention was directed to the fact that the photographic plate provides a very powerful instrument for investigations depending on the detection and measurement of the energy of heavy charged particles, notably protons, and of neutrons. It was shown that the method, when applied to determining the energies of the neutrons liberated from the light elements under deuteron bombardment, yields essentially the same information as that provided by the expansion chamber. The photographic method has, however, marked advantages over the expansion chamber, which were described.

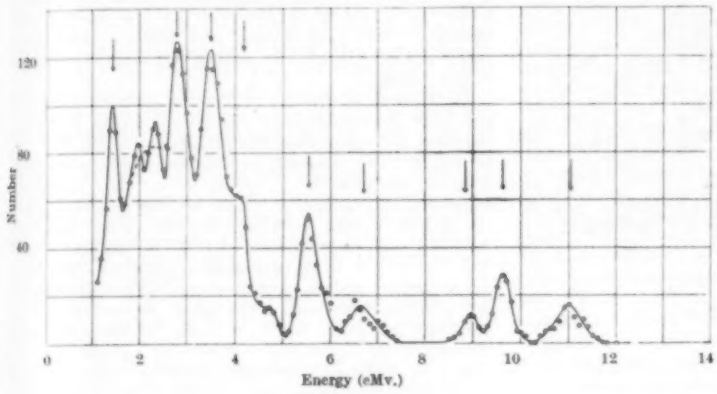

Fig. 1.

FORWARD NEUTRONS FROM F + D AT 900 KV.
Number per 200 kv. range plotted for every 100 kv. Peaks statistically justified are shown by arrows. Two tracks were also observed, at 13·2 and 13·6 eMv. respectively, which suggest slight boron contamination of the target.

The first experiments were made on neutrons of which the energy spectrum had already been investigated. It was, therefore, of importance to apply the method to an investigation in which previous work could not serve as a guide able to prejudice the experimental observations. Adequate checks were applied in the previous work and it is believed that the results are free from this objection, but nevertheless an independent experiment was desirable. Through the courtesy of Prof. J. D. Cockcroft and Mr. P. I. Dee, it was possible to examine the neutrons from fluorine under bombardment with 900 kv. deuterons from the Cambridge one million-volt generator. The results are shown in Fig. 1, and are taken from measurements on 1,700 tracks contained in 4 sq. cm. of an Ilford half-tone plate of which the emulsion was 100 μ thick. The results were obtained with an exposure of two hours with 30 microamperes in the resolved deuteron beam, the plate being at a distance of about 10 cm. from the target and in a position to detect forward neutrons. The measurements of the tracks were made by a single observer in about sixty working hours. We understand that the same spectrum has been investigated by Dr. T. W. Bonner using the expansion chamber, and that his results will be published shortly. We have not seen his results, and it will thus be possible to make a completely independent check on the validity of the photographic method. Two tracks of 13·4 eMv. protons suggest boron contamination of the target, and this may be responsible for the peaks at 4·3 and 9·0 eMv. Further work will be necessary to decide this point.

It was suggested in the previous letter that the photographic method is equivalent to a continuously sensitive expansion chamber. We believe it possible to press the analogy further in the sense that the spatial orientation of a track in the emulsion can be determined. With objectives of high aperture, the depth of focus is so small that it is possible to determine the depth of individual grains in the emulsion with a high degree of precision, and hence the angle of inclination of a track to the plane of the plate. In addition, the direction of the projection of the track on the plane of the plate can be measured to within a quarter of a degree and the direction in space thus defined. We have examined the distribution in angle of the protons ejected by the neutrons from boron under deuteron bombardment as they pass though the plate.

We and other observers have shown that the high-energy neutrons from this reaction fall into four groups with energies of approximately 4, 6, 8·7 and 13·3 eMv. when the bombarding deuterons have an energy of 600 ekv. If a neutron of energy E_0 is scattered by a proton, the energy acquired by the proton, if projected at an angle β with the direction of the incident neutrons, is $E_0 \cos^2\beta$. If we measure the range of protons projected in a photographic plate by the boron neutrons, we should therefore expect the ranges of the observed tracks to be distributed, according to the angle β, in a way corresponding to this energy equation. We should expect the points to lie, not on four lines, but within four bands as a consequence of:

(*a*) the straggling of the protons,

(*b*) the uncertainty of $\pm 2°$ in the direction of the neutrons entering the plate, owing to the width of the deuteron beam striking the target, and

(*c*) an uncertainty of $\pm 1°$ in the determination of β.

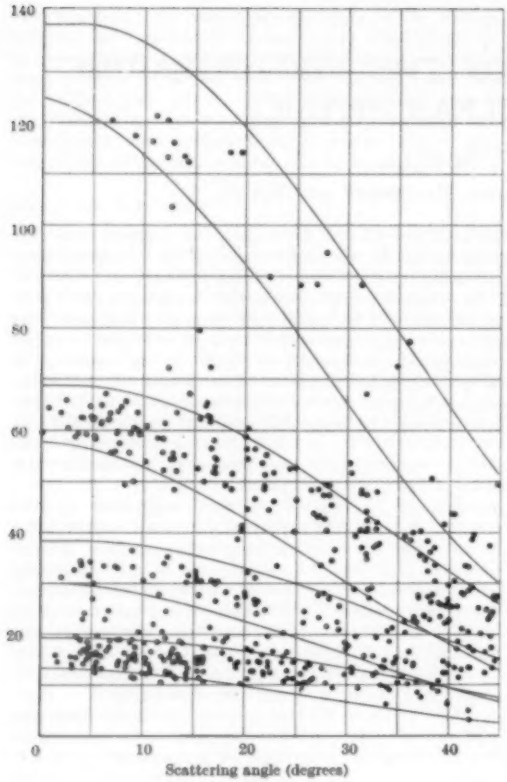

Fig. 2.

DISTRIBUTION OF RANGE WITH ANGLE FOR 500 PROTON TRACKS SCATTERED BY B + D NEUTRONS.

Tracks measured make angles up to ± 12° with plane of the plate. Range is plotted in microscope eyepiece scale divisions.

The bands shown in Fig. 2 are drawn by assuming a 'width' of 0·8 eMv. in the range at any angle due to straggling, and an uncertainty of ±3° in the determination of β due to factors (*b*) and (*c*). The results for the first 500 tracks measured are shown as points in Fig. 2, and it will be seen that 90 per cent of the tracks lie within the four bands. The results emphasize in a striking way one of the conclusions of the previous letter, that the photographic method has the advantage over the expansion chamber in that the amount of matter in the plate is so small that it does not give rise to scattered neutrons in serious numbers, and show that it is possible to investigate neutron-proton scattering at high energies by the photographic method. The measurements are proceeding.

The possibility of determining γ-ray energies by means of the photographic plate has also been investigated. Plates loaded with heavy hydrogen were exposed to the γ-rays from fluorine under proton bombardment and a search made for the photo-disintegration protons. The difficulty is that the cross-section per atom for the production of electrons in the emulsion by the γ-rays is about a thousand times greater than that for the photo-disintegration of the deuteron. Although many electrons must pass through a grain before it will develop, a limit is thus imposed on the time of exposure to which the plate can be subjected, beyond which the general background of fog makes it impossible to distinguish proton tracks. With the first plates available the deuterium content was too small to give a sufficient number of tracks per sq. cm. of the plate at the limiting γ-ray exposure. A layer of 'heavy' ammonium chloride, $(ND_4)Cl$, was therefore supported immediately above an ordinary half-tone plate during an exposure to the γ-rays. A large number of proton tracks was then observed in the developed plate, starting in the surface of the emulsion, and having a maximum energy of 2 eMv. We attribute these to the photo-disintegration of the deuterium under the action of the 6 eMv. γ-rays from the fluorine.

Although the application of the method to the determination of γ-ray energies can only be made in the absence of neutrons, it can be used in its present form to determine the spatial distribution of protons from the photo-disintegration process, an experiment which is of great importance for the meson field theory. This experiment, and further work with plates loaded with greater amounts of heavy hydrogen, is proceeding.

It is evident from the results published in our previous communication on the protons from the reaction $B^{10}—d,p$ that the photographic method can be applied to scattering experiments between fundamental particles, $p—p$, $p—d$, $p—\alpha$, etc., using the high-energy protons provided by the cyclotron, and we are at present collaborating with Prof. J. Chadwick on such experiments. Dr. T. R. Wilkins kindly informs me in a private communication that he is investigating proton-proton scattering at high energies by a similar method. The great advantage of the method for such work is that, in contrast with experimental methods employing counters, the particles scattered through different angles are all recorded at the same time, so that it is not necessary to apply elaborate corrections for maintaining the constancy of the bombarding stream or correcting for its variation. The analysis of the plates is much easier in these experiments than with neutron work, since the scattered particles all start in the surface and run parallel into the plate. Dr. Wilkins employs a camera carrying a large number of plates in this

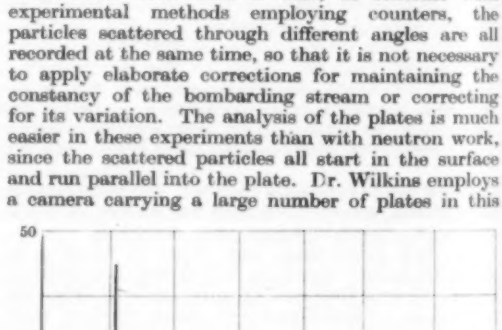

Fig. 3.

ENERGY DISTRIBUTION FROM ALL MEASURED TRACKS PROJECTED WITHIN 40° OF THE DIRECTION OF THE INCIDENT NEUTRONS.

type of experiment. We use a single rectangular plate with the proton beam running parallel to the long axis and a little above the plate. The beam, defined by stops, passes down the axis of a tube provided with a short interruption through which protons scattered by the gas in the camera can emerge to enter the plate.

A detailed account of the methods employed will shortly be submitted for publication in another place. It may be mentioned here that we find it a considerable advantage to use binocular microscopes and optical equipment of the highest quality to reduce the nervous strain on the observer to a minimum. Although the Ilford half-tone plate has proved very adequate for the work, it seems likely that it will be possible to develop special plates with superior characteristics for nuclear work.

THE VOCODER

AT the World's Fairs in New York and San Francisco great interest was shown in the speech synthesizer shown in the Bell System exhibits. In the December number of the *Bell Laboratories Record*, H. Dudley, of their research department, describes this device, known as the 'vocoder'. The 'voder' is an offshoot of a more extensive system first demonstrated in its experimental stage several years ago. It first analysed spoken sounds and then used the information to control the synthesizing circuit. As World's Fair displays were then under consideration it was seen that the synthesizer, manually controlled, could be made into a dramatic demonstration. Development was at first concentrated in this field, but when a successful Voder became assured, attention was shifted back to the broader and parent system and it was called the 'vocoder', since it operates on the principle of deriving voice codes to re-create the speech which it analyses. The analyser is at the left and the synthesizer at the right of the vocoder.

Electrical speech waves from a microphone are analysed for pitch by one channel and for spectrum by a group of channels. In the pitch analysis the fundamental frequency is called for simplicity the pitch. It is measured by a circuit containing a frequency discriminating network which obtains the frequency in a pure form, a frequency meter for counting, by more or less uniform pulses, the current reversals therein, and a filter for eliminating the actual speech frequencies but retaining a slowly changing current that is a direct measure of the pitch. The output current of the pitch channel is then a pitch-defining channel with its current approximately proportional to the pitch of the voiced sound and equal to zero for the unvoiced sounds.

There are ten spectrum-analysing channels, the first handling the frequency range 0–250 cycles and the other nine, the bands, 300 cycles wide, extending from 250 cycles to 2,950 cycles, a top frequency which is representative of commercial telephone circuits. The operation of the analyser is illustrated by a group of oscillograms taken in analysing the sentence "She saw Mary". In the analyser the speech wave is the input and the eleven speech-defining signals are the output; in the synthesizer the eleven speech-defining signals are the imput and the speech wave the output. The relaxation oscillator is the source of the buzz, and the random noise circuit the source of the hiss. When a voiced sound is analysed a pitch current other than zero is received, with the result that the buzz is set for the current pitch by the "pitch control" on the relaxation oscillator; also, the relay marked "energy source switch" operates, switching from the hiss source to the buzz source. From the loud-speaker comes speech approximately the same in pitch and in spectrum as the original.

The possibilities of the Vocoder were recently demonstrated by the author before the Acoustical Society of America and before the New York Electrical Society. In these demonstrations comparison is first made between direct speech and the best re-creation that the apparatus could make. Then by manipulation of dials and switches, speech is modified in various ways. Normal speech becomes a throaty whisper when the hiss is substituted for the buzz. Although the hiss is relatively faint, it is shown to be essential for discrimination between words like 'church' and 'shirts'.

Ordinarily the re-created pitch moves up and down with that of the original. If variation is prevented, the re-created speech is a monotone like a chant. When the relative variation is cut in half, the voice seems flat and dragging; when the swings are twice normal, the voice seems more brilliant; when four times normal it sounds febrile and unnatural. The controls can be reversed, so that high becomes low; the tune of a song is then unrecognizable, and speech has some of the lilting characteristics of Scandinavian tongues. By appropriate setting of the basic pitch, the voice may be anything from a low bass to a high soprano. If the basic pitch is set to maintain a constant ratio of, say, 5 to 4 to the original, this is a 'major third' higher and harmonizes with the original. In two-part harmony, the demonstrator can then sing a duet with himself. Connecting a spare synthesizer for a 3 to 4 ratio he can sing one part in a trio, the others being taken by his electrical doubles. Finally, with the basic pitch control of the apparatus, he becomes a father reprimanding his daughter, then the girl herself, and then becomes the grandfather interceding for the child. Keeping careful time with the puffs of a locomotive, the demonstrator can make the locomotive puff intelligibly "We're—starting—slowly—faster, faster, faster" as the puffs come closer together. A particularly striking effect is that of singing with an organ to supply the tones. Although the words may be spoken, the demonstrator usually sings them to hold the rhythm. It makes no difference whether his voice is melodious or not; the tonal quality comes only from the musical source.

The engineering possibilities which may grow out of the application of the principles employed in this device are hard to predict at the present time. The speech-defining currents, however, do have features of simplicity and inaudibility which may open the way to new types of privacy systems or to a reduction in the range required for the transmission of intelligible telephonic speech.

CATLIN AND HIS NORTH AMERICAN INDIAN GALLERY AND MUSEUM

By L. J. P. GASKIN

FEBRUARY 1 is the centenary of the opening of "Catlin's North American Indian Gallery and Museum" in the Egyptian Hall, London. George Catlin, American artist, traveller, and ethnographer, spent eight years, 1830–38, among the Plains Indians of North America, and was familiar with their life and customs at a time when the Indians were still living far from that civilization which was to overtake and destroy them so rapidly. His declared purpose from the outset was to preserve for posterity the likeness of aboriginal man in America, and his artistic ability and industry in this direction was shown to great advantage by more than six hundred portraits and sketches of the Indians, and of Indian life, hung round the walls of the Egyptian Hall. The Museum contained thousands of objects of Indian manufacture such as weapons, costumes, musical instruments, and domestic utensils so arranged as to form a pictorial history of those tribes thought particularly worthy of notice. In the centre of the room was erected a large wigwam from the country of the Crow Indians, made of buffalo skins, curiously ornamented with porcupine quills, and capable of housing eighty persons.

The history of the exhibition is interesting. After a four-year sojourn in London and the provinces it was removed to Paris, where it attracted the attention of Louis Philippe, who permitted it to be shown in the Louvre. Unfortunately, this Royal interest involved Catlin in great difficulties when the July Revolution of 1848 compelled him to leave France. Once again in London, he sought to recoup his losses by the rehabilitation of his exhibition, and this led to financial disaster: his collections were seized for debt, though they were freed later through the generosity of a fellow-countryman.

In 1852, Catlin set out on his travels once again, and on this occasion visited Central and South America. He returned to Europe in 1858, and busied himself with the formation of his "Cartoon Collection", copies of his original pictures, and much new matter from his later travels. He returned to America in 1870 to show this second collection in the Smithsonian Institution, and died in 1872.

For forty-two years he had laboured to improve and perfect his Indian collections, and to plead the Red Man's cause. His writings, particularly his "Letters and Notes on the manners, customs, and condition of the North American Indians" (1841), made him and his work known to a large circle of readers in Europe and America, and his portraits and sketches have been declared, by those well qualified to judge, as among the most truthful of the Red Indians ever presented to the public. But the most enduring monument to his memory will always be his two collections, now housed in the United States National Museum and the American Museum of Natural History.

NEWTON'S KNOWLEDGE OF THE RADIUS OF THE EARTH

IN a paper entitled "The Story of Newton's Inverse Square Law and his Use of a False Radius of the Earth" (*J. Brit. Astro. Assoc.*, **50**, 2; 1939), John Miller states that the story of Newton's alleged ignorance of the true radius of the earth is open to considerable doubt. The data at the disposal of Newton were the time the moon required to revolve around the earth and the moon's distance from the earth in terms of the earth's radius. The latter was known from the days of Greek astronomy to be about 60, and this was independent of the true radius of the earth. A few simple formulæ are derived by Mr. Miller, and from these a relationship is established between the true radius of the earth and certain constants, the basic assumption being the inverse square law. Miller's final formula enables the true radius of the earth to be found, but, of course, if a false value of the radius is used in this formula, the equality breaks down; in other words, the inverse square law seems invalid. It is alleged that Newton took the radius of the earth to be 3,440 miles, and as it was impossible to fit this value in with the inverse square law, his work was delayed nearly twenty years.

It is generally believed that Newton accepted the value of one degree of latitude as 60 miles, hence his difficulty with the fictitious radius of the earth, but, as Miller points out, Snell's measurement in 1617 gave 66·6 miles and Norwood showed in 1637 that 69·5 miles was a close value, while two years later Picard found a more accurate result, slightly less than Norwood's. It is remarkable that Newton did not make use of any of these in 1665–66 when he was engaged on his gravitational theory at Woolsthorpe. It is certain that he knew Snell's value in 1672, ten years before he was supposed to have recomputed his earlier results, because Varen's "Geography", published in 1672, contains an error which Newton corrected by using Snell's value for the length of a degree of latitude. Picard's accurate results were communicated to the Royal Society in 1672 on the day that Newton was elected a fellow, yet the story goes that he did not make any use of these until 1682. This delay of ten years seems inexplicable.

From an examination of the evidence from various other points of view, Mr. Miller concludes that the story is unauthenticated and that the real reason for Newton's delay of seventeen years in the publication of his "Principia" was the difficulty that he experienced in dealing with axial rotation, a problem to which Miller hopes to return in a subsequent paper.

ELECTRICITY AND GAS INSPECTION SERVICES IN OTTAWA

THE annual report of the Electricity and Gas Inspection Services of Ottawa for the fiscal year, ended March 31, 1939, has been published (Ottawa: King's Printer. 25 cents). It is addressed to the Department of Trade and Commerce, and describes the activities of the Electricity and Gas Inspection Branch from March 1938 until February 1939, with the work performed during the previous year. So far as the Electricity and Gas Inspection Services are concerned, the work performed creates a record. The total revenue was £2,400 more than the preceding year and there were 21,000 more meters tested. A decrease in the surplus is mainly due to the fact that the salaries of the headquarters staff are included in the statement for the first time. The amounts required to cover rent, fuel and furniture for the Services as a whole are not included in this summary. The expenditures incurred in the administration of the Electricity and Fluid Exportation Act are included in the amount charged against electricity inspection. This amounted to about £40.

Calorific tests of manufactured gas were made throughout the Dominion and the average heating value was found to be 489 B.T.U. per cubic foot. The standard required is 450 B.T.U. per cubic foot. The amount of natural gas supplied throughout Canada during this period was approximately 32,000 million cubic feet, an increase of 5¼ millions over last year. The total number of meters in service on March 31, 1939, was approximately two million, an increase of nearly 60,000 over the preceding year.

The periodic calibration and checking of the inspection standards, supplied to the various inspectors throughout Canada for outside companies and other departments of the Government, is performed in the laboratories of Ottawa, Winnipeg and Vancouver. The expenditure on electricity inspection was £55,000 and on gas inspection was £15,000.

The number of kilowatt-hours of electrical energy produced for export during the fiscal year 1938–39 was 1,940 million, an increase of 100 million over the preceding year. The number of kilowatt-hours produced for use in Canada by the exporting companies was 3,100 million electric units, as compared with 4,132 million during the previous year. The revenue collected by virtue of the export duty of 0·03 cent per electric unit shows a slight increase over the preceding year.

The Range Oil and Gas Company exported approximately 289 million cubic feet of natural gas from the Rogers Imperial structure in southern Alberta during the past year; and the Vanalta Oils, Ltd., exported approximately 27 million cubic feet from the Red Coulee field, also in southern Alberta. No revenue, except the licence fee, ten pounds for each licence, is obtained from this export.

THE McCOMB-ROMBERG SEISMOMETER

MODELS of this new tilt-compensation seismometer have recently been placed in the new seismographic station of the Nebraska Wesleyan University in Lincoln, Nebraska, in the Chicago Seismograph Station, and in Salt Lake City ("New Instruments and Equipment at Coöperative Seismograph Stations of the United States Coast and Geodetic Survey", J. H. Nelson and H. E. McComb, *Bull. Seis. Soc. Amer.*, **29**, No. 4, 549–588; Oct. 1939).

A few of its salient features are as follow: It rests on a one-piece brass plate having point-slot-plane positions for the seismometer footscrews. Around the edge of this base plate is a ploughed slot in which the edges of the metal cover rest Air currents and dust are effectively kept away from the boom and optical system. The column is relatively short and well braced against possible side sway. At the top of the column a worm-driven windlass provides easy and accurate adjustment of the length of the supporting wires from which the steady mass is suspended. The boom, a duralumin rod about 12 in. long has at one end a sapphire jewel which rests against a steel pivot mounted in the bottom of the column, and at the other end a vane of electrolytic copper which floats in the field of a cobalt steel permanent magnet. A rough auxiliary pivot with slow-motion screw mounted on the column to work against a brass cup on the boom is provided for protecting the main pivot and jewel at times of installation and adjustment. The mass is of brass, weighing 2,550 gm. The boom, damping vane and oil cup weigh about 130 gm. The magnet is mounted on guides and may be readily removed at times of determining free period and recording decay curves. The air gap may be easily adjusted by means of a knurled-head micrometer screw.

The optical system of multiplying lever and mirrors gives a nominal magnification of about 350. The seismometer cover is of thin sheet aluminium, provided with doors for adjustments and a glass window set so as to reflect stray light downwards and not into the optical system. Both the north-south and east-west components record on one Henson recorder. The speed of the drum is 15 mm. per minute (one revolution per hour), translating about 5 mm. per revolution. It is driven by a 60-cycle 110-volt synchronous motor through a train of cut gears. A single seismogram 12 in. × 36 in. in size is obtained. The east-west component records directly whereas the north-south component operates by reflection from a large first-surface mirror which gives no distortion.

SEVENTY YEARS AGO

NATURE, vol. 1, January 27, 1870

Tyndall on Haze and Dust

THE Friday Evening Discourse entitled "On Haze and Dust" delivered by Prof. Tyndall at the Royal Institution on January 21, 1870, is printed in full. Prof. Tyndall referred to experiments carried out at the Royal Institution, in which he passed a "powerfully condensed beam" of light through tubes originally exhausted and "optically empty", to which air from the laboratory was admitted after passing through potash and sulphuric acid. In every case, floating matter entered the tube, and revealed itself by scattering the light, showing the "conical track of the electric beam". If the air was heated before passing through the drying apparatus, the floating matter was burnt up. "It was therefore *organic matter*". Tyndall then tried different methods of heating the air stream. Imperfect combustion of the particles produced fine blue clouds in the experimental tube, which gave perfectly polarized light at right angles to the illuminating beam. He also reported experiments in which a heated body placed below a cylindrical beam of light produced wreaths of blackness like thick black smoke, due to air currents removing the scattering particles which made the beam visible.

Tyndall then went on to associate the "organic matter" which the flame consumes with the germs causing disease. For this he was taken to task in the leading article in the same issue. "Practically, so far as health is concerned, Prof. Tyndall has given us a scientific account, not only of certain optical properties of impure air, but likewise of the benefit of several popular practices, such, for example, as lighting fires during epidemics to purify the air, the use of gauze curtains in malarious districts as a protection against fever, covering the mouth with a cloth during sleep in fever countries, and the like . . . On the real proximate aerial cause of disease, if such there be, no new light has been yet thrown either by the optician, the microscopist, or the chemist."

FROM a correspondent: "Professor Struthers, of Aberdeen, and Professor Bell, of St. Andrews, hearing that the five ladies who are studying at the Edinburgh University are excluded from the opportunity of studying anatomy there, have severally offered their services as instructors. Many a lady will rejoice that the numbers of those willing and ready to help in the good cause of fuller knowledge for women are increased by two professors, who have bravely come forward with much moral courage and chivalrous feeling."

"WE are happy to be able to announce that the council of the Chemical Society has decided to have a report of their proceedings and an abstract of the papers read before the society drawn up immediately after its meetings, and to offer copies of this report to the editors of journals who may be likely to wish to publish it. The days when the newest results of science were regarded as something secret—or, at all events, of no concern to the ordinary man of education—are gone by, we trust, for ever."

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

DEMONSTRATOR IN BACTERIOLOGY—The Registrar, University, Leeds (February 3).

AN APPOINTMENT IN THE MECHANICAL ENGINEERING AND TRANSPORTATION (POWER) DEPARTMENT of the Indian State Railways—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (quoting Appointment 1/4A) (February 12).

LECTURER IN AGRICULTURAL BIOCHEMISTRY in the Massey Agricultural College, Palmerston North, New Zealand—Universities Bureau, 88a Gower Street, W.C.1 (April 15).

TECHNOLOGISTS—The Under-Secretary of State, S.2.G., Department Z.A., Air Ministry, Adastral House, Kingsway, W.C.2 (quoting reference number B.380).

TEMPORARY FORECASTERS, Grade II (Male) in the Meteorological Office—The Under-Secretary of State, S.2.B.(Met.), Department Q.A., Air Ministry, Adastral House, Kingsway, W.C.2.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

London Shellac Research Bureau. Bulletin No. 3: Iodine Values of Lac; Reaction between Halogen and Lac. By Dr. B. S. Gidvani and Dr. R. Bhattacharya. Pp. 14. Technical Paper No. 17: Ethers and Ether-Esters of Lac and their Polymerisation. By Dr. B. S. Gidvani. Pp. 24. (London: London Shellac Research Bureau.) [31

Department of Scientific and Industrial Research. Report of the Water Pollution Research Board for the Year ended 30th June 1939: with Report of the Director of Water Pollution Research. Pp. iii+40. (London: H.M. Stationery Office.) 1s. net. [41

Imperial Institute. The Mineral Industry of the British Empire and Foreign Countries. Statistical Summary (Production, Imports and Exports) 1936–1938. Pp. 453. (London: H.M. Stationery Office.) 7s. 6d. net. [41

Battersea Polytechnic. Report on the Work of the Session 1938–39, by the Principal, being the 46th Annual Report presented to the Governing Body. Pp. 36. (London: Battersea Polytechnic.) [91

Friends of the Hebrew University of Jerusalem. Annual Report 1938–9. Pp. 16. (London: Friends of the Hebrew University of Jerusalem.) [101

Hull Museum Publications. No. 205: On Dating Old Horse-Shoes. By Dr. Gordon Ward. Pp. v+38+7 plates. No. 206: Excavations at the Roman Town of Brough, E. Yorkshire, 1937. By Philip Corder and the Rev. Thomas Romans. Pp. ii+62+6 plates. (Hull: Hull Museum.) [101

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 2, No. 2, September 1939. Compiled by Agnes Elisabeth Glennie, assisted by Gwen Davies and Catherine Robson. Pp. v+113–198. (London: H.M. Stationery Office.) 4s. 6d. net. [101

Other Countries

Canada: Department of Mines and Resources, Mines and Geology Branch: Bureau of Mines. The Canadian Mineral Industry in 1938. Reviews by the Staff of the Bureau of Mines. (No. 804.) Pp. iv+102. (Ottawa: King's Printer.) 25 cents. [91

Publications of the Dominion Astrophysical Observatory. Vol. 7, No. 8: The Spectrographic Orbits of the Components of Boss 2112. By W. E. Harper. Pp. 149–154. (Ottawa: King's Printer.) [91

Field Museum of Natural History. Botany Leaflet No. 24: Mistletoe and Holly. By Sophia Prior. Pp. 30. (Chicago: Field Museum of Natural History.) 25 cents. [91

Scientific Publications of the Cleveland Museum of Natural History. Vol. 8, No. 2: A New Arthrodire from the Cleveland Shale Formation. By David H. Dunkle and Peter A. Bungart. Pp. 13–28+plate 3. (Cleveland, Ohio: Cleveland Museum of Natural History.) [91

Department of Agriculture: Tanganyika Territory. Pamphlet No. 24: Reports from the General Experiment Farms 1938. Pp. 48. (Dar es Salaam: Government Printer.) 1s. [91

Transactions of the San Diego Society of Natural History. Vol. 9, No. 14a: A New Subspecies of the Western Worm Snake. By Laurence M. Klauber. Pp. 67–68. Vol. 9, No. 15: Two New Pocket Gophers from the Desert Slope of Eastern San Diego County, California. By Laurence M. Huey. Pp. 69–72+plates 4–5. (San Diego, Calif.: San Diego Society of Natural History.) [91

Egyptian Government: Ministry of Public Works. Annual Report for the Year 1932–33. English Version. Part 2. Pp. 478+15 plates. (Cairo: Government Press.) P.T. 100. [101

Catalogues

Old Books of interest to the student of the Social Sciences. (Catalogue 54.) Pp. 42. (London: E. P. Goldschmidt and Co., Ltd.)

Level Measurement and Control. Pp. 24. (London: Negretti and Zambra.)

Marmite (Yeast Extract) in Medicine and Dietetics. Pp. 24. (London: The Marmite Food Extract Co., Ltd.)